

Museum Library

PL
671
.C74

JAN 28 1948
WILSON ORNITHOLOGICAL CLUB

FEB 7 1948

THE CONDOR

Volume 50

January-February, 1948

Number 1



JOURNAL OF THE COOPER ORNITHOLOGICAL CLUB

THE CONDOR

JOURNAL OF THE COOPER ORNITHOLOGICAL CLUB

Published bi-monthly. Entered as second-class matter May 15, 1925, at Berkeley, California, under Act of Congress of February 28, 1925, Section 412, paragraph 4. Issued from the office of THE CONDOR, Museum of Vertebrate Zoology, Berkeley 4, California.

SUBSCRIPTION RATES

Three dollars per year in the United States, payable in advance.

One dollar, the single copy.

Three dollars and twenty-five cents per year in all other countries in the International Postal Union.

COOPER ORNITHOLOGICAL CLUB

Dues are payable in advance on January first for the calendar year: Three dollars per year for members residing in the United States; three dollars and twenty-five cents in all other countries. Members whose dues are paid receive THE CONDOR without additional charge.

The life membership fee is seventy-five dollars. No additional dues are required, and the money is invested and the interest only is used for Club publications. Life members receive THE CONDOR without additional charge.

Send dues, subscriptions and notices of change of address to JOHN McB. ROBERTSON, Treasurer, Buena Park, California; orders for back numbers of THE CONDOR and the PACIFIC COAST AVIFAUNA series to W. LEE CHAMBERS, Business Manager, Robinson Road, Topanga, California, or to C. V. DUFF, Assistant Business Manager, 1922 Tamarind Ave., Hollywood 28, California.

MANUSCRIPTS

Send manuscripts for publication to the Editor, ALDEN H. MILLER, Museum of Vertebrate Zoology, Berkeley 4, California, or to the Associate Editors, JEAN M. LINDSALE and FRANK A. PITELKA, or to the Assistant Editor, ROBERT W. STORER, same address. Refer to suggestions on preparation of manuscripts for THE CONDOR on the back cover of recent issues of the journal.

Issued January 20, 1948

CONTENTS

	PAGE
Fiftieth Anniversary Volume [Dedication].....	3
Zone-tailed Hawk, Painting by Allan Brooks.....	5
Observations on Behavior in Captive Fulmars.....	5
Summer Observations of Birds on Okinawa, Ryukyu Islands.....	16
Analysis of Variation in Western Races of the White-breasted Nuthatch.....	26
The Curve-billed Thrasher in Oklahoma.....	40
FROM FIELD AND STUDY	
A Nesting Record for the Red Crossbill in California.....	44
The Starling in Arizona.....	45
Does the Poor-will "Hibernate"?.....	45
Eastern Kingbird in San Bernardino Valley, California.....	46
Second Record of the Golden-crowned Sparrow in Utah.....	46
An Early Record of the Western Kingbird in Lane County, Oregon.....	46
Horned Owl Feeding on Garter Snake.....	46
An Albino Eared Grebe at Mono Lake.....	46
NOTES AND NEWS.....	47

THE CONDOR

JOURNAL OF THE COOPER ORNITHOLOGICAL CLUB

VOLUME 50



Edited by
ALDEN H. MILLER

JEAN M. LINSDALE
FRANK A. PITELKA
Associate Editors

ROBERT W. STORER
Assistant Editor

W. LEE CHAMBERS
JOHN McB. ROBERTSON
C. V. DUFF
Business Managers

BERKELEY, CALIFORNIA
1948

General Lib.
Gift

Museum

AL

671

C74

FIFTIETH ANNIVERSARY VOLUME

In 1899 a small but ardent group of western ornithologists embarked on the publication of its own journal, The Bulletin of the Cooper Ornithological Club. After a year of development, this became The Condor, and today it begins its fiftieth volume. Fifty years is a long period in the West, and in this time changes in human occupancy, outlook, and custom have been profound. But the concern for the natural scholarship of bird study that initiated this publication remains as intense today. Indeed this study is now pursued by a company of members fifteen fold greater, of wide geographic horizon, and with a great catholicity of interest just so long as the real subject is birds. New techniques and accumulating information have complicated the field of ornithology and have shifted some points of emphasis, as they should. Science cannot stand still, yet how basically constant is our underlying purpose in the ornithological field, we appreciate when we note the present cogency of the statements of our first editor, Chester Barlow, in the first number of the Bulletin: "The West is rich in its possibilities of new discoveries, both in faunal forms and data regarding the life histories of many species, and through the field of a widely distributed corps of members, the Club hopes to present many papers of special value to science."

This volume of The Condor, as all past, and we trust many to come, we then dedicate to a never diminishing scientific curiosity about those animals of compelling interest, the birds. It is, moreover, a monument to those persons moved by the worthiness of this scholarship who have through changing times and recurrent difficulties devotedly given their energies to the writing, financing, and production of the fifty-year record of our studies.



ZONE-TAILED HAWK
Painting by Allan Brooks

THE CONDOR

VOLUME 50

JANUARY-FEBRUARY, 1948

NUMBER 1

OBSERVATIONS ON BEHAVIOR IN CAPTIVE FULMARS

By HENRY KRITZLER

The writer collected Pacific Fulmars (*Fulmarus glacialis rogersii*) in the winter of 1946-1947 in connection with an investigation of the physiology of stomach oil production. Four specimens were secured alive. Since very little concerning the behavior of Pacific Fulmars, wild or captive, has been reported, it seemed worth while to record some of the behaviorisms observed in these birds.

METHODS OF CAPTURE

Two methods of luring fulmars to baits have been employed. The first, less successful than the second, involves the preliminary attracting of gulls, with the hope of exciting the interest of passing fulmars. The collector is lowered in a small skiff from a larger vessel about five miles off shore. As soon as he releases the falls, the ship's cook, by previous arrangement, dumps the previous day's refuse into the sea. That this maneuver immediately attracts gulls in considerable numbers goes without saying. The collector then sets out his baits, which consist of pieces of salt pork each fastened to at least three number 12 treble hooks, which, in turn, are secured to a length of light wash line floated with corks. If there are any fulmars in the vicinity, they are likely to be drawn to the scene by the activity of the gulls. If a fulmar does appear, it wastes no time, as a rule, on the garbage, but immediately investigates the baits, which seem to interest only the more daring, or perhaps, less experienced gulls. The chief disadvantages of this method are interference by gulls and the temporary nature of the lure, that is, the ship's garbage either sinks or is soon consumed.

The second method, which is to be preferred since it attracts petrels but does not excite the interest of gulls, is the salt pork grease method attributed by R. C. Murphy to R. H. Beck. If the sea is very calm, it proves quite reliable. The collector either rows out to sea from shore or is lowered from a larger vessel. In addition to the baited line referred to previously, he is equipped with a small gasoline stove and a considerable quantity of salt pork grease which he has prepared on shore. When he reaches a point far enough off shore to be assured of meeting fulmars (about two miles seems to be enough, although the birds are frequently seen on the seaward edge of the kelp beds), he lights the stove and melts some of the grease. When it is hot and crackling, he pours a little on the sea, and rows on. He sets his course so that when he has created a slick of pork grease a half mile long and a hundred yards wide, he may drift at one end of it. Whale blubber oil was tried, but the film formed by this material was too delicate and was broken up by the slightest breeze. He then sets out his baits and occasionally drops a little more hot grease over the side.

If a foraging fulmar, flying low over the surface of the ocean, crosses the slick, it is as good as in one of the sacks waiting in the bottom of the boat. It will promptly double

back and forth, coursing up drift along the slick not unlike a hound on a fresh trail, seeking the source of the fat. When it sees the baits, it will alight on the water, swim up and commence tearing at them without any preliminaries whatever. Such a slick will cause Black-vented Shearwaters to deviate from their courses, but birds of this species are interested neither in refuse nor in baits. The fulmars tear at the baits by grabbing them with the hooked tip of the maxilla and pulling back vigorously. This tendency—to tear their food, rather than to wolf it as do the gulls—results in the birds being hooked by the tip of the beak rather than by the tongue or pharynx. They will duck under for baits suspended under water, but the writer has not seen the fulmar dive.

On February 6, 1947, the writer captured three fulmars in a morning's "fishing." The first bird sighted the slick and came to the baits at 9:00 a.m. It started tearing at them immediately and was so adept at bait stealing that forty-five minutes elapsed before it was caught. Four times during this period the bird was enticed so close to the boat that attempts to snare it with a casting net were made, but each time it darted out from under the mesh. This threat to its freedom was not recognized as such and it was not in any way deterred from returning to the baits. About twenty minutes after its arrival, a second fulmar appeared. Each time the second bird approached the baits, the first fulmar drove it away, actively snapping at the wings and neck of the former. The victim emitted a throaty clucking noise, but the aggressor was silent. At about 9:45 a.m., the first fulmar was caught and placed in a sack, whereupon the second fell upon the baits as though famished and was caught about three minutes later.

Later in the morning, a third fulmar was seen resting quietly on the sea about fifty yards away. A quantity of grease was poured on the water, and as soon as the edge of the slick reached the bird, it swam up and commenced sampling the baits. A minute or two later it was in a sack in the boat.

Of the many extraordinary characters which distinguish the petrels, their utter fearlessness is by no means the least. It is unquestionably a corollary of the adaptation to pelagic life. Mammalian predators probably affect them only during the breeding season and such enemies must be few, judging from the general inaccessibility of their nesting sites. The otic infection which kills hundreds of adults and offshore gales are probably the factors chiefly responsible for holding fulmar populations in check. Bent (1922) cites several references to the trust shown by both the Atlantic and Pacific races. So the fulmar brain probably contains no innate mechanism whereby its owner is apt to respond distrustfully with regard to human beings. The birds are apparently so constituted that, when suitable food is available, they are incapable of associating the manner in which it is presented—in this instance, on hooks—with possible hazard to themselves. Not so, of course, with the gulls. Usually, as soon as a gull perceives that bait is attached to a line, he drops it and moves away. If hooked, the gull seems immediately to associate its predicament with the human on the other end of the line. The fulmars pull back when drawn toward the boat, but with none of the obvious terror which motivates the wild thrashing of the gull. One may hoist a fulmar over the side with no more ado than in landing a smelt, but it takes some exertion to haul in a gull. The petrel seems unconcerned about anything except that somehow it has become entangled. The gull seems to be more aware of the actual state of events. Not until it was grasped by the head did any of the petrels seem to be concerned by the presence of the writer. None regurgitated oil at the time of capture. In the sacks, they constantly poked about, seemingly looking for a way out and occasionally they uttered a plaintive chirp, which, in reality, may have been a sneeze and not a true vocalization. Their activity in the darkness within the sacks is perhaps correlated with the fact that most petrels are normally as active in the dark as in daylight. Gulls are completely quiet, once confined in sacks.

MANNER OF CONFINEMENT

The four fulmars were kept in an outdoor, concrete tank, four feet by eight, with constantly changing sea water at a depth of five to ten inches. As a rule, the birds were separated by wooden partitions, a measure made necessary by the mutual antagonism displayed at feeding time. The tank was enclosed by a double cage of chicken wire which, because the petrels were unable to surmount the walls of the tank, served mainly to protect them from molestation. Each bird was provided with a wooden feeding tray and a wooden platform upon which to rest. Three of the birds showed no concern, at any time, about being confined. Not even when they were evidently hungry did they behave as though they had ever experienced any other environment. The fourth, which incidentally was the poorest feeder and the first to succumb, spent most of its waking hours



Fig. 1. Captive fulmar climbing on platform.

butting against the wall as though seeking a way out. When the partitions were removed, this bird attacked all of the others with savagery not entirely associated with greed for food. The only times at which the remaining birds showed fear were first, when the writer entered the tank to clean it, and second, whenever he made an unmistakable move to grasp one of them. His presence at the entrance of the cage seemed usually to be viewed with quiet, alert interest rather than with fear.

USE OF THE PERCHING PLATFORMS

The writer was astonished at the alacrity with which the fulmars accepted and made use of the perching platforms. Out of deference to the weakness generally characteristic of procellariiform legs, the platforms were constructed to clear the water by not more than two inches and were equipped with cleats to provide purchase in climbing. At first, the use of the hooked bill and of the wings was indispensable to getting the initial toenail hold in climbing onto the platform. In the future the writer plans to equip the platforms with duck boards extending into the water. The fulmar swims to the edge of the platform, reaches forward and hooks the tip of the maxilla over one of the cleats, paddling vigorously, flaps its wings and finally gets a toenail or two hooked on the edge. Then, still pulling with its beak and using its pectoral appendages as arms rather than as

wings, it hoists itself up on the structure (fig. 1). After several weeks of captivity, the fulmar's legs grew strong enough to enable them to hop from the water onto the platform with no help from the bill and only a vigorous flap or two of the wings. When leaving the platform, the birds were obliged to scramble off, but were later able to jump into the water. The fulmars rested on the full length of the tarsi. Occasionally these were raised above the outwardly projecting side feathers as the bird rested on its broad, well-padded ventral surface. This sometimes gave rise to a ludicrous situation arising from the bird's holding itself down by the side feathers when it would attempt hurriedly to rise and get into the water. When the bird elevates itself to stretch or to cackle, it may lift its body on the phalanges alone, the tarsi being raised to an angle of more than forty-five degrees from the horizontal.

When the tank was drained for cleaning, the petrels would stand motionless with the tarsi almost vertical for fairly long periods. When the writer entered to scrub the floor of the tank, a wild panic would usually ensue, the fulmars madly scampering about, tripping and tumbling over one another in their efforts to avoid him. Only the first few steps, in such instances, would be taken on partially extended tarsi.

The eagerness with which the fulmars made use of the platforms is in agreement with the reports, cited by Bent, of the manner in which birds of the Atlantic race scramble onto floating ice when they have eaten so much that they cannot fly. Yet one would suppose that a bird which spends three quarters or more of the year at sea would prefer to rest on the water. It may be safely said that at no time did these petrels actually *rest* on the water in the tank, since they entered that medium only to avoid the observer, to feed, to exercise, or to engage in some other sort of overt behavior. They invariably slept on the platforms, although, in the wild state, they must perforce sleep on the ocean surface at times, at least. Very likely the Pacific birds ride on icebergs also. It would be very interesting to determine whether or not they rest on flotsam in the lower latitudes.

SWIMMING AND BATHING

The fulmar is an agile, if not particularly speedy, swimmer. The remarkable denseness of its ventral plumage which, in good condition, is extraordinarily water repellent and the boat-hull shape of its ventral contours serve to make it extremely buoyant. The upper two segments of the legs are used hardly at all in swimming, motion being restricted to the tarsus and webbed toes almost exclusively. When idling, the legs are fairly relaxed and the tarsi tend to extend laterally as they are waved gently back and forth. When turning and pivoting, they are also extended laterally. But when swimming more energetically, they are extended downward and quite a good deal of thrust is brought to bear in such swimming patterns as plunging in the bath, stretching and exercising the wings, in the peculiar sort of water treading associated with feeding to be described subsequently, and in taking off into flight.

The captive fulmars have demonstrated a remarkable fondness for bathing. One wonders just what sensory impressions evoke the bathing response. One of them was observed to bathe continuously for more than an hour on several occasions. This bird eventually drowned, partially as a result of what seemed to be its inability to satisfy an uncontrollable urge to bathe. The fulmar starts the bath by rearing up repeatedly on rapidly paddling feet, before ducking its head under for the first time. The head is raised immediately after the plunge, water being thrown over the back. The plunge is repeated rapidly, the breast being raised well off the water with the bill depressed before the head and neck go under. When the bird begins to become soaked, the wings are spread on the surface to aid in supporting the body and to give additional purchase in rearing for the next plunge. The birds become thoroughly sodden and bedraggled after

some minutes of this, so much so that a good deal of the natural buoyancy is lost. Much of the bird's body then sinks, the use of the spread wings becoming quite essential to prevent foundering. They often become so drenched that they are hardly able to crawl back onto the perching platforms. Two which eventually were found dead in the water evidently succumbed because of inability to regain the safety of the perching platform. That neither of them was malnourished was attested to by the fact that autopsy revealed richer subcutaneous and visceral fat deposits than the writer has seen in *any* bird. It is possible that because the birds received a diet containing a plethora of fat, their lipid metabolism was deranged in the direction of storage at the expense of normal utilization, with a resulting inability properly to anoint the plumage with preen gland wax. The preen glands were fat and one of the birds had produced copious quantities of stomach oil which differed markedly from that described in the literature (see below).

This foundering or wallowing seemed not to diminish the bird's interest in continuing to bathe at all. It is possible that something about inadequately oiled plumage evoked sensory impressions undistinguishable to the birds from those which normally induce bathing in the wild. On the other hand, wild birds may bathe quite as vigorously without encountering the hazard of a thoroughly sodden plumage.

The preening which followed the bath was ordinarily performed on the perching platform. It differed in no noticeable respect from that seen in other birds. The birds were quite able to preen while sitting on the water, as may be supposed.

FEEDING

The diet of the captive fulmars was, for reasons dictated by the physiological experiments for which they were obtained, restricted to hog tissues. Hog lung, liver and heart were given *ad libitum*. The material was cut into small pieces and was placed on the wooden feeding trays. Usually the birds rested on the water while feeding, but if the perching platforms were placed near the trays, they would not always bother to enter the water. Choice morsels would be picked up from the dry concrete floor of the tank when it was drained for cleaning purposes. One bird almost invariably jumped from his perching platform into the water only to scramble out onto the feeding tray, consuming the meal while standing on the full length of the tarsi (fig. 2). If, in his haste, he assumed such a position that his toes only supported him on the tray, his precarious balance was partially supported on half-extended wings. These observations indicate that the fulmar, unlike certain other, more or less primitive sea birds, is capable of recognizing food out of the water. The fact that the feeding trays were used from the first day in captivity shows that this was not due to learning and suggests that when circumstances render it useful, the fulmar may at least clamber upon objects large enough to support it while feeding in the wild.

When the fulmar feeds from the water, it swims up to the tray, selects a morsel, backs away, and proceeds to manipulate it before swallowing it. The food may be shaken from side to side in the water, masticated, and, if it is dropped, retrieved by ducking the head under. The gape is then spread, the mouthful swallowed, and the bird returns to the tray for another morsel. After several have been swallowed, the birds invariably resort to the water treading maneuver alluded to earlier. In this, the legs are paddled vigorously and the entire ventral surface of the bird is raised clear of the water. The wings remain folded, as a rule. Quite a swirl of water passes under the bird as it "treads water." This may be repeated several times before the bird resumes feeding. The frequency with which the behaviorism occurs increases as the meal progresses, until the bird can eat no more. At least two explanations for this behavior pattern occur to the writer. It is possible, on the one hand, that it enables the bird to achieve easy and orderly pass-

age of bulky food particles into the proventriculus, which is a large organ extending throughout the length of the body cavity. Since the sternum is short, the greater portion of this part of the alimentary tract is separated from the exterior only by the thin abdominal wall and the ventral plumage. It is thought that the bird senses the entry of food into this structure and is so stimulated to perform this characteristic response. On the other hand, this performance may only be an homologue of the manner in which the fairly closely related whalebirds cause eddy currents to bring plankton toward their



Fig. 2. Captive fulmar feeding on platform.

open beaks while feeding. It was mentioned that a considerable swirl of water passes under the fulmar as it "treads water." It may be that, in the wild, fulmars also induce floating food particles to move in their direction in this manner, the mechanism being automatically evoked as an integral portion of the feeding response, whether or not the desired result is achieved.

Sea water is drunk in generous quantities before, during, and after the meal. The water is swallowed directly, without dependence on gravity as seen in most terrestrial birds. When the fulmar can eat no more, it will toy with food for some time before turning its interest to some other activity. A bath frequently follows feeding.

Bent stresses the fulmar's fondness for fatty food. The captive fulmars have rendered excellent substantiation to this report. Out of deference to this character, which seems to be based on a physiological requirement as yet to be worked out, the diet of the captives was always supplemented by small chunks of pure lard. A typical response to this supplement is as follows. As the writer placed chunks of liver, heart and lung on the tray which was, as the bird was well aware, within his reach, the petrel sat on its platform, clucking eagerly and showing great interest in the proceedings, but not

daring to come within reach. But when the three or four cubes of lard were dropped on the tray, all fear was forgotten, and the bird literally jumped off the platform, landing with a splash near the tray, to down the lard as fast as this could be done. He would then back away to await the writer's withdrawal before resuming feeding. Those portions of the food which were light colored were selected first. The dark red liver, far more nutritious, and, in fact, more fatty than either the lung or the heart, was left to be eaten last.

From the very first, the petrels were able to select the more desirable lard from among the other morsels, probably primarily because of an innate tendency to choose light colored food, and secondarily because of association processes. Pieces of heart and liver which sank to the bottom at the shallow end of the tank were occasionally retrieved by ducking, but they accumulated in the deep end, where the bottom could be reached only by diving, a maneuver to which they never resorted.

The food was preserved in the freezing compartment of a refrigerator and was therefore very cold when fed. This did not deter the birds from consuming it rapidly, although the body temperature was often sufficiently lowered to cause violent shivering. Although wild fulmars often feed with wings extended, the captives usually did so with wings folded.

The writer suspects that, with regular feeding times in captivity, the fulmars became accustomed to responding to food with greater regularity than is probably the case in the wild. Their occasional indifference to food when first caught prompts him to conclude that wild fulmars eat to the point of complete satiation when the opportunity presents itself and will then perhaps ignore food until the enormously distensible proventriculus is once again empty enough to evoke the sensation of hunger.

VOCAL BEHAVIOR

Bent quotes Stejneger as commenting on the "whinnying voice" of the "glupisch," and Captain Collins as reporting that the fulmar (Atlantic race) confines itself to a sort of chuckling sound, somewhat resembling a low grunt. He also quotes Morris who states "The noise that a large flock make is almost deafening, something between the cackle of a hen and the quack of a duck." Bent himself reports observing "a [Rodgers fulmar], presumably a female [that was] sitting on a ledge when a male flew up and alighted beside her; with his beak wide open and his head thrown back until it pointed straight upwards, he slowly waved his head from side to side uttering a soft, guttural, croaking note." This was interpreted as a courtship performance.

The statement is frequently made that the fulmar is a silent bird as a rule, and the writer's observations support this contention wherein it applies to lone individuals. But when others of its kind are about it can be very active vocally. All of the sounds the writer has heard these birds make seem to be derived from a basic croak, perhaps identical with that reported by Collins. This croak may be described as a short, guttural *uck*. When food was presented to the birds the croak was repeated rapidly with the bill almost if not quite closed, the sound becoming a sort of *buck! buck! buck!* When the birds were grasped the croak became a rasping *aaark! aaark!* given through open beak as the bird snapped and struggled in its effort to escape. When one bird was attacked by another, it would emit a *buck! buck!* somewhat similar to that used in anticipation of feeding. But the most elaborate derivative of the croak is what the writer terms "cackling" and which probably is identical with the cackling reported by Morris. When two birds approached one another, the complacent clucking of one would suddenly break into a strident *äh, äh, äh, äh, äh, äh, äh, äh, üh-üh-üh-üh-üh!* As this call was given, the beak was opened fairly wide, the head was raised and the bird's attention was di-

rected toward its companion. The outburst was either greeted by the other bird in kind, or with the more subdued *buck, buck* (fig. 3). Occasionally, particularly on windy days, the petrels were very active vocally and cackling duets were heard repeatedly. The significance of this behavior is as yet unknown. Sometimes, when the cackling had been indulged in for some time, one of the birds, if sufficiently "warmed up" would start "braying." This braying, unlike the ordinary cackling, seems to be produced by alternate inhalation and exhalation, just as in the quadruped with which braying is usually



Fig. 3. Attitude characteristic of fulmars while cackling.

associated. Thus we have an *āh, āh, āh, āh, āh, āh, āh, āh, āh, ūh-ūh-ūh-ūh-ūh-ūh-hongh-ūh-hongh-ūh-hongh-ūh-hongh!* The expiratory honk is deep and resonant.

Lone birds were never heard to make any sound except the rasping, snarling croak which accompanied their efforts to escape from one's hands. Thus all the other sounds may be ascribed to social responses. The clucking and cackling may be elicited by imitation. The cackling is certainly indicative of an emotional outburst, because while doing so the fulmars may raise themselves, extending the tarsus if perched, or paddling vigorously if sitting on the water, and fanning the air vigorously with the wings. Conclusions as to the significance of these sounds will have to be deferred pending study of the birds in the field.

OBSERVATIONS ON STOMACH OIL

A physiological character which distinguishes the Procellariiformes from other water fowl is the ability to produce in the proventriculus, which is a secretory stomach rather than a crop, a waxy oil which is regurgitated in response to noxious stimuli and when feeding the young. The ornithological literature is rich in references to this phenomenon. Murphy (1936) has presented a concise discussion of the problem, stating that "the function of the oil is not known, beyond the fact that it is discharged as if in defensive reaction, when the birds are approached." He goes on to comment upon the several hypotheses that have been hazarded as to its function. He discounts the supposition that it serves as food for the young on the basis that "the oil does not contain the quantity of protein that would be expected." Yet large quantities of this oil accumulate in the digestive tracts of young petrels, so much in fledgling Atlantic Fulmars that the natives of the Faeroe Islands are said to have used them as candles. When fledgling "mutton birds" are exploited for their oil by the natives of New Zealand, the carcasses are suspended by the head to keep the oil from running out. It must be borne in mind that

fledgling petrels and albatrosses, which are usually fed but once daily and which are abandoned by their parents before they are able to fly (three months or more in the Wandering Albatross), have a real problem in water metabolism. When an animal's physiological economy has so evolved that it must depend on the combustion of food for its water supply, an highly adaptive lipid metabolism usually appears. Witness the high fat content of egg yolk, the fat deposits in the camel's hump and in the tails of the Gila monster and the Australian fat-tailed lizard. The enormous fat deposits in female bears which lactate for months during hibernation without feeding are certainly the source of the water secreted in the milk. It is not altogether unlikely that the oil regurgitated by the petrels constitutes the fledgling's water supply. The proteins requisite for differentiation and growth could be supplied in the form of semidigested material regurgitated with the oil. The high hydrocarbon content of the oil would surely provide sufficient energy and water for growth, not to say survival only, when the fledgling has been abandoned on its nest or in its burrow. That there seems to be a relation between the reproductive process and the regurgitation of oil is supported by the fact that the oil has not, to the writer's knowledge, been observed in any of the larger petrels which occur during their respective non-breeding seasons in California waters. No trace of the oil has been found by the writer in healthy fulmars collected in December, January and February, but the captive fulmars commenced oil production in March. It would therefore seem that the possibility that the oil constitutes food for the young should not be ruled out without further study.

Murphy also feels that Hagerup's conclusion that the oil is merely an undifferentiated product derived from the bodies of minute crustaceans is not warranted, since the oil occurs in petrels which have not eaten crustacea and in young birds which have fasted for long periods. It is likely that Hagerup's conclusion was precipitous, but there is a possibility that the oil does arise as a relatively undifferentiated product of partial digestion of not only crustacea but also of other marine organisms, such as squid, which may have fed on crustacea before being consumed by the petrels. The writer has not yet failed to find squid bills either in the proventriculus or in the gizzard of any fulmar or shearwater he has examined. Moncrieff (1946) points out that ambergris, another lipoidal material of musky odor, found in the digestive tract of the sperm whale, an exclusive feeder on cephalopods, is a residue of incomplete digestion of these mollusks. The Merck Index, however, states that ambergris contains about 80 per cent cholesterol, wherein it differs markedly from petrel oil. However, it is possible that there is some relationship between feeding on squid, which seems to characterize most petrels, and the production of the proventricular oil. That there is considerable similarity in chemical composition between petrel oil and spermaceti may be a relevant point (Rosenheim and Webster, 1927).

The proposal of Rosenheim and Webster, who analyzed oil taken from a fledgling Atlantic Fulmar, that it represents an accumulation of preen gland oil (which has a similar composition) hardly seems tenable in view of the absence of stomach oil in non-breeding birds. However, there is no reason to suppose that the stomach oil, when available, does not supplement the product of the preen gland, for indeed, the feathers of freshly collected petrels and, in fact, those of very old petrel skins, invariably smell of the odor attributed to the oil. When petrels are producing stomach oil, it may be present in such abundance that it will bubble and spatter at the nostrils concurrent with respiration (Murphy, Bent).

The fact that petrel oil has a relatively high melting point (it is in fact a wax, rather than an oil) makes dubious the validity of the hypothesis of Green (1887) that the material may be used "to calm the troubled surface of the sea about the birds during

severe storms" (quotation from Murphy). For this purpose, an oil which remains fluid at low temperatures is needed.

Rosenheim and Webster showed that the ruby red color of the unsaponifiable matter of fulmar oil is due to carotenes. It was with the view of testing the possible secretory origin of the oil and its pigment that the diet of the captive fulmars was restricted to hog tissues, which contain no carotenoid pigments whatever. Only one brief experiment was performed and that on a single bird. This individual, after it began to regurgitate oil in March, could be relied upon to produce from five to twenty milliliters of oil, when sufficiently provoked, at any time after that. The technique of obtaining the sample is simple. One enters the enclosure with a large beaker in one hand, and after cornering the bird, annoys it with his free hand, by snatching at its tail and allowing it to snap at his fingers. Presently the bird begins to gasp and wheeze. The beaker is placed in front of or over its head, and in a few seconds the sample is violently ejected. If the bird is taken into the hands, there is less likelihood of securing a sample. The regurgitation seems quite involuntary and in no sense may be construed as being directed with reference to the source of annoyance. The occasional appearance of a lump of partially digested food shows that when only oil appears, it does not follow that no solid food is contained in the proventriculus. This ability to regurgitate liquid and retain solids is an extraordinary adaptation.

After several control samples of oil, which on superficial examination resembled nothing so much as rancid pork grease, were secured, the bird was subjected to a course of injections of a 1:9 mixture of alpha- and beta-carotene suspended with the aid of Tween 80 (Atlas Powder Co.) in a minimal volume of 0.9% aqueous sodium chloride. The suspension was injected on alternate days, subcutaneously in the region of the right breast, each dose containing about 2 milligrams of pigment. At the time of each injection and for a period of two weeks after the last (a total equivalent to 12 milligrams having been given), oil samples were secured. No detectable trace of carotenoid pigment was found in any of these samples. On autopsy, prodigious deposits of subcutaneous and visceral fat were found, and the only tissue containing any carotene was the subcutaneous fat overlying the right breast and axilla. The fact that the bird failed to assimilate the injected pigment may have been linked with the almost pathological deposition of depot fat. The unusually fatty diet to which it was subjected may have swung its fat metabolism so far to the storage side that it was incapable of normal utilization. However, the fact that the oil which was regurgitated by this bird more closely resembled pork grease than the petrel oil described by Rosenheim and Webster may lend support to the hypothesis that the proventricular oil is a digestive by-product rather than a secretion.

SUMMARY

Fulmars were caught on hook and line after being lured to baits by the commotion caused by gulls feeding on garbage or by a hot pork grease slick. The petrels took the baits without hesitancy and could hardly be frightened away from them. Consistent with this tameness, while they were still free, was the calm with which they accepted captivity. For birds which spend most of their lives at sea, the fulmars showed a remarkable preference for resting on solid platforms, onto which, at first, they could climb only with great difficulty.

An unusual penchant for bathing was possibly due to abnormal plumage condition resulting from a diet restricted to hog tissues. In feeding, the fulmars showed preference for light-colored food, particularly fat. The birds fed either from the water or while perched on feeding trays. A curious paddling performance associated with feeding was noted.

Four types of vocalization were observed, three of them obviously social in function. No production of stomach oil was observed during the winter months either by wild birds or by the captives, but the oil produced by the latter after the middle of March more closely resembled rancid pork grease than the oil described in the literature. The several hypotheses concerning the origin and function of the stomach oil are discussed.

ACKNOWLEDGMENTS

This study was one of several projects performed by the writer during his tenure as National Research Fellow in Zoology for 1946-1947. To the National Research Fellowship Board in the Natural Sciences, for enabling him to visit the Scripps Institution of Oceanography, and to Dr. H. U. Sverdrup, Dr. D. L. Fox, and Dr. C. L. Hubbs, for the opportunities, equipment and guidance furnished him, he expresses his gratitude. He is also indebted to the Cudahy Packing Company, North San Diego, California, for the donation of the hog tissues fed to the petrels.

LITERATURE CITED

- Bent, A. C.
1922. Life histories of North American petrels and pelicans and their allies. U. S. Nat. Mus. Bull. 121:xii + 343 pp.
- Merck and Co., Inc.
1940. The Merck Index (Rahway, New Jersey, Merck and Co., Inc.), 5th ed., viii + 1060 pp.
- Moncrieff, R. W.
1946. The chemical senses (New York, John Wiley & Sons, Inc.), vii + 424 pp.
- Murphy, R. C.
1936. Oceanic birds of South America (New York, American Museum of Natural History), vol. I:xxiv + 640 pp.
- Rosenheim, O., and Webster, T. A.
1927. The stomach oil of the fulmar petrel. Biochem. Jour., 21:111-118.

The Scripps Institution of Oceanography, University of California, La Jolla, California, August 20, 1947.

narrow isthmus in the south-central part the interior becomes more and more rugged with roads only near the coast, while south of the isthmus numerous roads criss-cross the island providing ready access. The population of both natives and service personnel was much thinner in the northern half of the island than in the south, except at certain points along the west coast.

The base camp near which much of my observing took place was situated one-half mile inland from the west shore of the island on the high bank of the Bisha Gawa (river), here a tidal stream about 50 yards in width, although just a creek a mile farther upstream. The obvious, widespread ecological associations, as indicated by the vegetation were: (1) pines, not unlike *Pinus radiata* of California, the large trees only around better residences and ceremonial tombs, but small to medium trees widespread in the hill regions; (2) abandoned sweet potato and rice terraces with strips of intervening grassland; (3) broad-leaved trees of abandoned native villages, the windbreaks around each lot usually of banyan—but no “riparian” strip, as cultivated or rocky land extended to the water; (4) the river and its tributaries; (5) beaches and coral platforms extending a varying distance offshore, especially in the bays. No trips were taken into the un-



Fig. 5. The lower Bisha Gawa, from camp on Okinawa. Pines cover the high banks of this tidal section of the river.

settled country of the northern part of the island, although the west coast road was traversed as far as Nago twice and as far as Shana Wan once. One trip by truck and one by foot were taken through the central isthmus area. From the isthmus southward frequent trips were made across the island by truck (which I usually could not stop to observe birds), and several trips were taken to the southern portion of the island, including one completely around the southern cape.

Ardea cinerea. Gray Heron. One was seen in rice and reed beds near Awashi on May 30, and 7 on tidal flats of Naha Lagoon on September 26, all in company of the next species. Appearance and habits were similar to those of *A. herodias* of North America at the distance at which I observed them.

Butorides striatus. Streaked Heron. Evidently a migrant or winter visitant, at least along the Bisha Gawa, since it was not found on mid-summer trips along that river but was there regularly after September 19. A total of 4 birds in 2 miles of stream on October 6 represents my maximum count. They were always very wary—much more so than the Green Heron of North America in my experience. They perched regularly in pines on the cliffs fronting the lower river and were nearly impossible to approach within good binocular range in that position. Such good views as I had were

obtained by careful stalking along the top of the cliffs to peer down at the birds feeding in shallows 60-70 feet below. In their feeding habits, flight, and appearance at a distance they were similar to the North American species, but at close range the thorough grayness of the plumage was markedly different. Of note also was their silence; at no time, even when frightened into sudden flight, did they give a call note of any kind.

Casmerodius albus. Common Egret. Identical in appearance with the American form of this species. I saw them at three widely separated points on the island: (1) Awashi (rice paddies and reed beds), flock of about 35 on May 30, 12 on June 6, none there on August 31; (2) Yakada (coral platform near small offshore islets), 1 on September 8, 2 on September 23, all in company of Reef Herons; (3) Naha Lagoon (shallow, mud-bordered estuary), 34 on September 26. The disappearance of the Awashi birds between June 6 and August 31 suggests migratory movements, at least locally. The birds at Naha were apparently feeding on the frog-like (but long-tailed) amphibians so abundant on the muddy shores.

Egretta garzetta. Little Egret. Only 5 birds were positively identified as this species: a single bird on the Bisha Gawa near camp on August 22, and four well separated birds in the shallows of Naha Lagoon on September 26. These were all observed closely, the lustrous black bill and legs, yellow feet, and slender neck all being noted.

Demigretta sacra. Reef Heron. A total of about 15 individuals was seen at various points along the rocky west coast or on the coral platforms in bays between June 6 and October 2. The gray phase and the white phase were represented in approximately equal numbers; no distinctly mottled birds were seen.

Nycticorax nycticorax. Black-crowned Night Heron. During late May and early June, and again in late September and early October, lone herons were seen flying up the Bisha Gawa at late twilight or were heard giving a *quok* call while flying overhead in the darkness. On October 5 a bird believed to be of this species was flushed from windbreak trees in the abandoned village of Nakaza near the southern end of the island; its white underparts and blackish upperparts were briefly but well observed.

Gorsachius gotsagi. Brown Night Heron. Two herons the size and shape of a night heron and rich rufous-brown in color were seen on July 15 flying over the tall grass of fields in the shallow, open valley east of Naha. Two other similar birds were seen over fields near Baten Ko on the southeastern coast the same day; but none of these was seen at close range. Caldwell and Caldwell (1931) emphasize the general brown appearance under recognition marks of this species, and no other species listed for the Ryukyu area by Hachisuka *et al.* (1942) is so described. Therefore it seems that the brown color would indicate that the birds which I saw were of this species.

Pandion haliaetus. Osprey. Apparently a fairly common migrant. Four records as follows: September 19, Bisha Gawa, one passed over at low altitude, apparently migrating; it glanced up and down the river bed as it passed it at right angles, but did not veer from its course; September 21, Yakada Bay, one foraged over the shallow sea above coral flats; September 23, Yakada, one flew from the bay inshore and soared up over the mountains to the northeast; September 26, Naha Lagoon, one perched on the limb of a pine jutting out from a small rocky islet (Ono Yama).

Falco tinnunculus. Kestrel. On October 11 a small hawk, definitely of falcon proportions, flew southward over the Bisha Gawa at tree-top height. This species is the only small falcon listed from the Ryukyus (Okinawa not specified) by Hachisuka *et al.* (1942).

Turnix suscitator. Chinese Button-quail. These quail were the most difficult birds to observe satisfactorily that I have ever found. From June 18, when one flushed from under my feet near the upper Bisha Gawa, until late September nearly all my records are of quick glimpses of birds rising quickly in irregular flight and settling so suddenly again into tall grass or weeds that I could never get binoculars focused on them. On these brief views the plumage was seen to be of a rich light brown or orange-brown, some individuals (supposedly males) much brighter than others. The wings were long for the body size, as compared with North American quail.

On September 17 near our camp I finally saw one bird on the ground when it scuttled along the border of a sweet potato terrace under the overhanging grass blades. It was a dull-plumaged bird, the wings and back mottled with dark brown, with no evident tail. I saw quail at several localities in the central part of the island, always in similar situations—abandoned vegetable fields and the grassy terraces separating them or sometimes in medium to dense brush intermixed with scattered pine trees. Kuroda (1925:201) lists this species as common on Okinawa.

Gallinula chloropus. Black Gallinule, or Water Hen. A pair, accompanied by at least one two-thirds grown young, were found in the matted down rice and weeds of flooded paddies in the bottom of a small gully off the upper Bisha Gawa on September 10. The old birds scurried out of the water and up the brushy hillside when I came suddenly around the slope; but the young one tried hiding along the bank, finally struggling over the small dike into the next higher paddy. Two half-completed nests floated on the shallow, open water in the center of the paddy field. On September 26 another

gallinule, answering the descriptions of the immature of this species, was seen at close range on a small pond in the abandoned village of Matambashi in southern Okinawa.

Pluvialis dominica. Golden Plover. Apparently not nearly so common on Okinawa (up to October 12 at least) as in the Hawaiian Islands. My first record was in late August, followed by single birds on September 5, 12, and 17 at inland areas of short grass or bare earth, flocks of 2 to 4 from September 8 into October on sandy beaches and coral platforms, and the maximum flock of about 10 birds on October 12. The last were frequenting the runway of a busy airfield near the east coast of the island, flying from one spot to another as they were disturbed by planes or trucks.

Smaller plovers thought to be Dotterels (*Charadrius mongolus*) also were noted.



Fig. 6. Offshore islet in Yakada Bay, Okinawa. Shorebirds, Reef Herons and Egrets fed on tidal flats.

Charadrius alexandrinus. Snowy Plover, or Kentish Plover. Recorded from August 9 to October 2, with a maximum of 6 on September 25. Most of them were on beaches near the mouth of the Bisha Gawa, foraging out on the sandy portions of the exposed coral flats at low tide. In similar habitat were single birds seen at Kurawa on August 21, and in Yakada Bay on September 8, and two in Yakada Bay on September 23, while one at Naha Lagoon on September 26 was the only individual observed on a tidal mud-flat.

The plumage was noted as essentially similar in the field to our North American Pacific coast form. The legs, however, were dull greenish. When feeding, they habitually carried the bill at an angle of about 30° below the horizontal, as contrasted with the "dotterels," which raised the head until the bill was horizontal between each feeding "run." The snowies frequently attempted to hide by squatting, but the "dotterels" never did so far as I determined. As a consequence the snowies could be approached much more readily than the "dotterels"; and even when both were feeding together the snowies would sometimes remain behind when the "dotterels" flew.

Numenius phaeopus. Whimbrel, or Curlew. One was seen at Yakada Bay, September 8 and 23; one alighted on the rocky retaining wall of the tidal portion of the Bisha Gawa on September 25; and three were seen in flight over Naha Lagoon on September 26, the last giving a loud *krek, krek, krek* call. All had prominently whitish lower backs and rumps, indicating the subspecies *variegatus*, and differing thereby from the American form, *hudsonicus*, with which I was familiar. The head striping seemed less marked than in *hudsonicus*, the central light line being very narrow, and the dark lines through the eyes were incomplete on the lores. The bill appeared dark except for reddish flesh color at the base; the legs were grayish green. The Yakada Bay bird fed chiefly by picking up from the surface of the wide area exposed at low tide, but occasionally it probed with the bill up to its full length. They were all wary, as I could not approach them in the open closer than about 75 yards.

Tringa nebularia. Greenshank. On September 23 I saw one in a brackish (or fresh?) stream near the beach at Yakada. It was foraging below muddy banks overhung by tall grass and pandanus trees, gathering some kind of animal food which must have been very active in attempting escape. Although obviously a relative of the Yellow-legs, I could not positively identify the bird until I checked my notes with descriptions in Caldwell and Caldwell (1931), wherein the white lower back, rump and most of the tail, blackish bill fading to bluish-gray basally, and greenish gray legs all taken together are considered diagnostic of this species. I noted all these points at the time of observation.

Both when on the ground and in flight, the bird gave a note similar to that of the Yellow-legs—*weee-weee, whu-whu*, the last two notes lower and harsher.

Actitis hypoleucos. Common Sandpiper. These teetering sandpipers, so like the American Spotted Sandpipers in habits, were apparently coincident with the tattlers in arrival and departure. Several were on the lower Bisha Gawa in late May, but none was seen thereafter until August. By late August there were 4 to be found at all times along the river between Owan and Hiza bridges (tidal stream) and from 1 to 3 in early September on the strictly fresh water stream above Hiza. One was also seen on September 10 at a small artificial lake in the hills north of the upper Bisha Gawa, and one on September 17 at a small rain pool in a new dirt fill near our camp. On September 20 one was seen at a range of about 15 feet as it chased insects at the border of a roadside field (dry) north of the lower Bisha Gawa.

On the rocky and coralline beaches they were of regular occurrence throughout September and early October, with maximum counts of 5 in 2 hours on September 8 and 23 at Yakada, 13 on September 25 along the Bisha Gawa near its mouth, and 20 in 2½ hours on September 26 around the mud-flats of Naha Lagoon, where several were flushed from water-filled bomb craters in the abandoned vegetable fields.

Their regular call note was a sharp *peet-weet*, not so musical as that of the Spotted Sandpiper. I did not hear it uttered in the long series given by the latter species.

Heteroscelus incanus. Wandering Tattler. On May 24, two days after my arrival at Bisha Gawa, there were at least 3 tattlers foraging regularly on the rocky banks of the tidal stream and in the muddy areas of nearby rice paddies. A single bird at the same locality on May 31 was apparently the last of northward moving migrants, since the species was not recorded again until August 9. By August 20 they were fairly common on rocky beaches of the central section of the island and from 1 to 3 were present daily along the lower Bisha Gawa. A count of 15 seen in 2 hours of walking across the extensive coral flats at Yakada on September 8 and a count of 12 in a 2½ hour walk around the inshore end of Naha Lagoon (mud-flat) on September 26 were the maximums recorded at any one locality.

Tattlers which I saw on Okinawa appeared identical in habits with those on Oahu in the Hawaiian Islands. They fed on mud flats and sandy areas near the more favored rocky shores as well as on the rocks themselves. The call notes of the Okinawa birds, however, I interpreted as less often trebled or quadrupled: a clear whistled *cher-weeee* or sometimes merely the rising *weeee(t)*, rather than the *chi-lée-lée* of the Hawaiian birds.

Arenaria interpres. Ruddy Turnstone. On the sand and coral rubble beach areas near the mouth of the Bisha Gawa two were seen on September 17 and again on September 25. On the 17th, the day after a violent typhoon, there was still a stiff wind blowing, against which the turnstones could barely make headway in flight. They spent some time huddled in the lee of a sand bluff one foot high, and then fed first with a Wandering Tattler and then with a single Snowy Plover.

Sterna sumatrana. Black-naped Tern. Apparently fairly common locally around the coast of Okinawa, breeding on nearby islands according to Kuroda (1925:192). I recorded it in late May, and through August in the larger, open-mouthed bays on both east and west sides of the island (Nago Wan, Kinmu Wan, Nakagusuku Wan). Close views were obtained only on August 14 south of Nago on the west coast, where 6 to 8 birds foraged up and down just offshore.

The plumage is so extensively white that at a distance they look just as white as the White Tern (*Gygis alba*). At close range, however, the very pale gray mantle was visible and the black crescent on the nape was noticeable. Their wing beats were more regular than those of most terns; this is also true of the White Tern. When feeding over a calm sea, they frequently swooped down and snatched something from the surface after the manner of a gull, yet without dropping the feet as a gull would do. No call notes were heard.

Sterna albifrons. Little Tern. Recorded as follows: June 27, Awashi, 1 adult foraging over shallow water of coral flat; July 14, mouth of Bisha Gawa, 16, 12 of them at rest on the tide-exposed coral, including 2 immature birds still begging food from any adult which approached them on the wing.

The adults were, for field purposes, identical with the Least Tern (*Sterna albifrons*) of North America except that they had dull red instead of orange-yellow feet. The immatures, however, seemed much less brownish than those of the Least Tern at the same stage. The Okinawa birds had no noticeable brownish in the plumage except for a slight tinge on the tips of the crown feathers; nape, dark gray to blackish at sides (behind eye); middle of back light gray as in adults; feathers of scapulars and primaries broadly edged with black, some (at least on scapulars) with an added very light gray tip; secondaries and inner primaries, white—the whitest part of the wing; rump white, fading into light grayish along the vanes of the spread tail; tail not noticeably forked; feet dull gray or grayish-yellow; bill lead gray.

The adults gave a slight, sharp *kack* occasionally. The immatures tittered musically when old ones approached.

Streptopelia orientalis. Turtle Dove. These large doves were apparently well distributed over the island, but were nowhere common. They were exceedingly wary. Out of a total of 18 different meetings with them, from May 22 to October 11, only on 5 occasions was I able to approach them closely enough to observe details of their plumage through binoculars. They seemed larger to me than the congeneric *S. chinensis* with which I was familiar in southern California and Oahu, as well as differing in field characters by having a paler whitish crown, bronzy coloration on the flight feathers, a patch of pale bluish containing white spots on the side of the neck, and a dark gray tail with a pale gray tip.

Their favorite feeding grounds seemed to be the abandoned villages and the borders between pines of the hills and the terraced paddy fields of the gentler slopes. One was seen on a small brush-covered island on the coral platform off the mouth of the Bisha Gawa. The largest number seen on any one date was 12, on October 5, on a trip around the southern part of the island. In the abandoned village of Nakaza on that date they were feeding on berries of the banyan windbreak trees. I did not hear them call at any time.

Alcedo atthis. River Kingfisher. These sparrow-sized kingfishers frequented the Bisha Gawa both along the tidal and the upstream portions, and they were also noted at several points along the rocky west coast north nearly to Nago. Maximum count along the nearest 1 mile stretch of the Bisha Gawa (tidal portion) was 4 (pair, plus 2 "singles").

Their flight resembles that of a small speedy sparrow. With the big bill projecting in front as they fly, they reminded me also of an overgrown hummingbird. It was odd to see them buzz out horizontally from a streamside rock or twig and then veer downward into the water, still buzzing, only to reappear almost immediately buzzing back to a perch. After making several unsuccessful sallies into the water the male of the pair which lived adjacent to our camp would return to a perch and jerk his head up and down vigorously. This species seems to be rather silent as compared with the Belted Kingfisher of North America, but I occasionally heard them give a shrill *tswee-tsee-tsee-tsee-tsee-tsee* when in flight, and a single *pip* when perched.

Halcyon coromanda. Ruddy Kingfisher. One record: On October 5, in the abandoned village of Nakaza near the south end of the island, one flew across the windbreak-lined courtyard affording a fine, though brief, view of its bright reddish brown plumage with lens-shaped patch of light blue on the lower back and rump.

Hirundo rustica. House Swallow. Fairly common, especially along streams such as the Bisha Gawa and over fields adjoining them or the beaches, or even over the coral tide flats themselves. I recorded them along the west coast as far north as Shana Wan (August 21) and south to the Bisha Gawa, where they were present at least from May 24 through October 10.

The male of a pair seen regularly by our camp was engaged in courting activities on June 7, even carrying a rootlet to a beam under the ruins of a bridge, but no nest developed at that point. On July 24 at least 13 swallows collected on wires over the river gorge just upstream from this point, among them being many in obvious juvenal plumage; thus, they nested somewhere nearby.

These breeding birds were assumed to be of the subspecies *namiyei*, listed by Hachisuka *et al.* (1942) for the Ryukyus. The males present during June and July all had notched tails without particularly elongated lateral rectrices, although they were otherwise much like the Barn Swallow of North America with somewhat paler underparts below the pectoral crossband. On September 8, at Yakada, 10 or more were resting on wires over rice and sweet potato fields. Several of these were males with very long lateral tail feathers, so I concluded that they were migrants of another subspecies (probably *gutturialis* of Japan proper). They also allowed a much closer approach than the summer resident birds. On the same date some were foraging up over brushy hillsides even to the crest of the ridge in the narrow center of the island, and also about some of the islets in Yakada Bay. On September 26 migrants were common everywhere on a trip around the southern third of the island, an estimated several hundred being seen. By September 29 this large flight had apparently passed on.

On October 9 and 10 swallows were foraging in the river gorge during the waxing and waning stages of a very destructive typhoon, keeping mostly within the protection of the river banks, but rising every now and then into the gale (against which I could barely stand upright) only to be tumbled crazily about and to drop back into the less violent air. One foraged for some time up and down a small road cut between our camp and the river, rising into the wind at either end of its beat and just skimming the mud in the center. Sometimes it would be blown almost out of control at the turns, but again it managed quick dashes through the trees and over the hillside grass and brush despite wind velocities estimated at 70 to 80 miles per hour.

Pericrocotus roseus. Ashy Minivet. Present in small numbers, usually in pairs, about the lower Bisha Gawa and in the low plateau to the north, from the time of my arrival in late May through mid-August. Then none was seen until September 25 and 26, at which time flocks of 10 to 35 birds suddenly appeared and roved up and down the river valley for a few days, apparently leaving about

October 1, except for a few stragglers (1 on October 11, the day before I left). Three at Nakaza, $\frac{1}{2}$ mile inland from the southern end of the island, on October 5, were the only ones I saw at any point far from our camp area.

The flight of minivets, especially when in flocks, resembles that of waxwings, except when about to alight, for then the long, slender tail is jerked forward and slows them to a sudden stop. A noisy, wheeling flock of 35 on September 25 surprised me by the suddenness of their descent into the pines, followed by utter silence. In late May pairs engaged in chases through the tree tops and called a rapid *pill-a-pill-a-pill-a-pill*, and the same call was heard, though less frequently, through August. The note given by flocks in flight, however, I interpreted as *chidl-dl-dl-dl-dl*.

Two plumage patterns were evident in the fall birds, one with much black about the head projecting into the ear region and with black tail and primaries marked with much white, the other with a pale gray head, neck and back darkening on the tail and primaries, but with the same white markings. The latter I assumed were immatures.

Corvus leuallantii. Jungle Crow. On all trips into the central uplands or north along the west or east coasts of the island (August 14 to September 21) crows were seen which answer the description of this species in Caldwell and Caldwell (1931) except that the bill did not seem heavier than that of the American Crow (*C. brachyrhynchos*). They were found chiefly on the pine-covered hillsides away from villages, only once being seen in a clump of trees in a small terraced (and formerly cultivated) valley between two hills. Not over 8 were seen on any day's trip.

These birds all gave similar calls—a drawled, hoarse *gwaarh* and a shorter *cawh*. They were extremely wary and could not be approached on foot, all good views that I obtained being of birds flying past me as I stood still. Their flight was quite similar to that of the American Crow.

Parus major. Great Tit. Fairly common, chiefly in the windbreaks and other broad-leaved trees of the abandoned villages or on hillsides where pines were mixed with at least a few broad-leaved trees. A pair was frequently found in the summer in and near our camp area. On my trip into the hills of the central isthmus on September 8 at least 3 pairs were found in a mixture of pines, broad-leaved trees, and brushland. On August 30 and several subsequent dates I found them foraging in company of white-eyes in the sort of loose aggregation common among winter birds of the northern forest areas. Their foraging seems to be done anywhere in the trees or in the brushy understorey, but I never saw them high in a tall tree.

The two most frequently given call notes I set down as follows: (1) *ka-cheedl-cheedl-cheedl*; (2) *ichik-ichik-ichik-ichik* in diminishing volume. Away from the Bisha Gawa area (strangely never from the pair in camp) I also heard them call: (3) very rasping *tsee-kidl-kidl-kidl-kidl*, quite wren-like and yet may be just a rapid and harsher variation of call number 1. On October 7 I heard one give still another call: (4) a churred trill—*tsee, tr-tr-tr-tr-tr-tr*.

Ixos amaurotis. Brown-eared Bulbul. Throughout the Bisha Gawa area, in the trees and bushes of the hillsides, this jay-like bird was common. Bultubs were wary and it was only with careful stalking plus a good deal of luck that I finally approached one close enough to see the characteristic brown ear patch. They are much darker in general plumage than the subspecies of Japan proper (*I. a. amaurotis*). They were assumed to be of the subspecies *I. a. pryeri* listed by Hachisuka *et al.* (1942) from all the Ryukyus.

Elsewhere than along the Bisha Gawa I saw them on all trips through the hillier portions of the island. They were numerous in the wilder country north of Nakaoshi on both of my trips up the west coast in August. In similar habitat on August 30 through the east-central portion of the island the few seen were less conspicuous because they were not nearly so noisy as earlier. On September 8 about 25 were seen during four hours of hiking through the hills east of Yakada. On October 6 at least 7 were found in the abandoned village of Kadena (approximately $\frac{1}{2}$ mile square) and 13 were counted along $2\frac{1}{2}$ miles of the upper Bisha Gawa. They seemed most abundant just before I left the island, 10 being estimated in $\frac{1}{2}$ mile of river bank and adjoining hills just above our camp on October 11; perhaps there was an influx of migrants.

The Brown-eared Bulbul has quite an extensive vocabulary, which heightens its likeness to jays. I listed at least five different notes: (1) A harsh *zrack, zrack, zrack, zrack, zrack*, given by both birds of a pair as they go long distances in shallow pitching flight. Often they become silent upon alighting again. (2) A two-syllabled wheezy whistle, *whéee-chack, wheee-chack*. This also is given by both sexes and may go on for some time while they remain hidden on a perch. (3) A hoarse *char-r-r-u*, sometimes given by one bird while the other keeps giving note number 2. (4) A soft, almost whispered *cheee, cheee, cheee, cheee, cheee*. This is heard infrequently. (5) The two birds together, one calling *chi, chā, teeeea-teeeea-teeeea*, the other interspersing with a harsh *chack—chu—chack*.

Bultubs perched in our camp area ceased calling immediately upon discovering an approaching human, and resumed their noise, with call number 1, only after flying halfway across the river.

Monticola solitarius. Red-bellied Rock Thrush. This species was one of the first birds with which I became acquainted on the island and my notes concerning it are extensive. A few excerpts from my daily record follow:

May 22 and following days. Owan Mill (ruins of sugar mill). One pair regular about the ruins of the mill, especially the smokestack, and up through the scattered pines and other trees on nearby hillsides to rocky river banks. Their forage range seems to cover a large area and seldom do the birds stop near the mill to hunt for food. Their favorite grounds are rocky ridges along the river, with pines being used for perching. They have some of the demeanor of a robin, but without the erect head when on a perch. The tail is slowly wagged up and down after alighting. Their flight is usually very direct with only occasional pauses in the wing beats.

June 6. I climbed the rusty ladder on the 40-foot broken-off smokestack and saw their nest at close range where I had seen the male bringing food intermittently several days before and both sexes during the last few days. The nest is placed on a brick ledge inside and under the bent-over metal portion of the broken-off top of the stack, thus perfectly shielded from rain. The base of the nest was composed of rootlets and small rocks (mostly coralline) up to 1½ inches in diameter intermingled with a few twigs, graduating upward into dry pine needles with which it was presumably lined. There were 5 young, all presenting a wide, lemon-yellow gape. The bit of down that could be seen (on head) was neutral gray. Their eyes were not yet open; I estimate them about 4-5 days old. Their food call was a slight *seee-lseee-lseee*. As I neared the top of the ladder, the female flew down from the nest and hopped about the top of the brick wall scolding with a metallic nasal *pee(n)t* repeated every few seconds. With each alternate scold she would bob her head downward and tail upward, remaining in normal perching attitude on the other notes.

June 8. The male makes fewer trips to the nest than the female. He also carries more before going in to feed the young, usually stopping on a brick wall, then the metal top of the stack, or sometimes even going up to the top of the nearby tall smokestack (90 feet above ground), and often waiting on his final perch as much as 30 seconds while the young give their food call from the nest. When he does go in, he returns promptly with a fecal sac and flies off beyond the river (400 yards away) before dropping it.

June 12. The female was at the top of the nest stack when the male came flying up to the wall with food in his bill. Both called with melodious whistles (which compose their song, but unlike that of the Dipper). Then the male began what appeared to be a courting display. He teetered drunkenly along the narrow brick wall with upraised and half-fluttering wings, leaning far to the left for a while, then far to the right. This lasted 15 to 20 seconds, during which the female fluttered her wings and both birds called frequently.

June 13. The food call of the young has increased to so insistent a begging that it is the first sound I hear in the morning as I struggle to wake up in my cot 150 feet away from the nest.

June 16. Young no longer heard in the nest (14-15 days after hatching); but neither could I find parents carrying food to them outside. The nest is so situated that they would have had to fly across the open top of the stack and below the bent-over metal underneath which the nest was placed; I think they may have fallen down the stack, which leads to an underground flue of the old mill. Male and female both still around, the male singing as usual at dusk.

June 18, 19, 20. The female sat at various points around the mill ruins calling in monotonous repetition an indrawn *wheeeep*, occasionally alternated with a grating *clacket-t-t-t-t*. The male not seen.

June 20. First juvenal out of nest found on rocky cliff above the river some 400 yards from the nest. It may or may not have come from the mill nest. It was mottled slate gray above with typical thrush-like spotted breast, stubby tail feathers with white tips, bill yellow. One was seen in same locality on the 30th.

July 4. Two immatures, in plumage now resembling females, but with white-tipped tail feathers, were feeding on lantana berries at Owan bridge. They were very tame in contrast with the adults.

July 29. An immature male seen which showed red in patches on belly.

August 9. One flew along the river bank as late as 7:30 p.m. when it was so dark that the new moon and 2 stars were plainly visible. Owan mill birds still sing morning and evening.

September 12. Two miles north of the lower Bisha Gawa a male on a new coral fill in an old vegetable field was doing the semblance of the wing-shuffling, tipsy acrobatics seen on June 12.

October 1. Two immature males were disputing perches on rocks along the river bank. Both sang short warbled phrases when in flight.

October 5. Nakaza, near sound end of Island (½ mile inland); 4 or 5 in this area; here there are denser trees and brush than those in which I have previously seen them. Ruins of tile and stone buildings provide the rocks, but most of their activity was in the windbreak trees! An immature male and one female were engaged in courtship preliminaries.

Elsewhere than at places mentioned above this species was seen commonly along the west coast of the island at least as far north as Shana Wan (August 21), where they often forage on rock outcrops along the shoreline, on the dead coral ledges at low tide, or even on the sandy beaches nearby. The farthest inland that any was seen was ¾ mile up the Bisha Gawa.

Cisticola juncidis. Fan-tailed Warbler. Common in grassy areas and old sweet potato fields at all altitudes throughout the southern half of the island, but they often use small pines or bushes for perching. Also seen on August 14 and 21 in suitable areas along the west coast north to Taira and Shana Wan, and on August 30 along the east coast north to at least 2 miles beyond Yaka.

From late May through July the flight songs of the males were prominent along roadsides everywhere except in the more densely wooded areas. Caldwell and Caldwell (1931:123), writing of the subspecies *tintannabulans*, say: "The peculiar characteristic which definitely identifies the bird is the flight, when it will arise to a considerable altitude and remain poised in the air with an up-and-down and bobbing motion, uttering its 'pete pete pete pete' call, suddenly to drop to earth with a series of sharp, clicking notes."

I interpreted the note of the Okinawa birds as a *jil-jil, jil-jil, jil-jil, jil-jil*,—etc., one double note being uttered at every change of direction in the jerking flight. The erratic plunges the male makes in giving this flight song often carry him low over the spot in the grass where the female is hiding or feeding. When she flies, he follows and continues the performance over her new location. Besides the song thus given, they (both sexes, I think) have a shrill sharp whistle, *keet, keet, keet, keet, keet, keet*, given both in flight or from a perch. The flight songs diminished in frequency during August, but these latter calls were given at all times during my stay on the island. The last song heard was on October 5.

This species was very difficult to approach; but after several trials I succeeded in observing both males and females, and one supposed immature on September 29, close enough to take detailed notes on the plumage, which tally closely with Caldwell and Caldwell (1931), except that the males were yellowish rather than "buffy-rufous" on the breast and belly, but the yellowish fades into white on the throat and shades into rufous-tan on the flanks and rump.

Phylloscopus borealis. Arctic Willow Warbler. Birds attributed to this species were seen in increasing numbers from September 25 to October 11, the day before my departure. On the latter date 8 were counted in a ½-mile walk among the scattered pines around the abandoned village of Kadena near the Bisha Gawa. On September 26 two were seen in a tangle of *Hibiscus* trees southeast of Naha lagoon. The following description was written at that time: warbler size and form; tail shorter than in American warblers, slightly notched at tip; bill a little heavier than in American warblers; upperparts greenish-olive to more brownish on top of head and on wings and tail; light buffy or cream-colored superciliary; dark brown to black line through eye; throat and belly whitish, the breast washed with olive green in tiny, obscure streaks; bill horn-color; legs dark (color?); one short wing-bar evident, but not prominent. They flashed their wings open and shut like a Ruby-crowned Kinglet as they foraged indiscriminately through the trees and bushes in warbler manner, but without "flycatching" outside the canopy.

Kuroda (1925) lists *P. b. borealis* as "Migrant and not common on Minami Daito and Yonahuni" [extreme eastern and southern islands in Ryukyu area] and *P. b. xanthodryas* as "through Japan, China, Riu Kiu Islands, Formosa, and Borneo. Migrant—not common on Iriomote [southern Ryukyus] and Minami Daito."

Hemichelidon griseisticta. Gray-spotted Flycatcher. One record: one on October 7 in an area of scattered pines with lantana underbrush on the cliff above the Bisha Gawa and with broad-leaved trees at the river bank. It perched much like the smaller American tyrannids, regularly on the lower limbs of the pines either within the canopy or under it. Its flight, however, was with more irregular wing beats and rather warbler-like; and it did not return to the same perch after a sally to capture an insect. These sallies were made mostly to points within or very near the canopy of the trees, but several were down to the top of the lantana underbrush. No call notes were heard.

According to the description of this species in Caldwell and Caldwell (1931), to which my notes correspond closely, this species is "unmistakable." Kuroda (1925) says of the subspecies *H. g. griseisticta* in the Ryukyus: "Migrant and not common on Minami-Daitojima and Yonakunijima. Mr. Yaita obtained one specimen on Tanegashima." These islands are at the extreme locations in the Ryukyu Archipelago, east, south and north, respectively.

Motacilla cinerea. Gray Wagtail. Starting with 5 on September 10, this species became increasingly common along the Bisha Gawa until on October 6 I counted 16 on a two-hour walk up the upper river. They usually fed at the edge of the stream or about the rocks and earthen banks undercut by the stream. Although I frequently heard and saw them flying over in groups of 1 to 3, I found them on the ground away from streams on only two occasions, both by mud puddles in the streets of abandoned villages.

The call commonly given in flight or from the ground is a light *yip* or *yip-yip*. On October 6 one of a group of three flying ahead of me up the rocky stream bed gave a sharp *tsee—pin, pin, pin*.

Sturnia philippensis. Red-cheeked Starling. Migrant or winter visitant. The first one was seen on September 26 in a tangle of *Hibiscus* tree branches on the shore of Naha Lagoon, while both the bird and I took refuge from a sudden shower. It fed on insects by leaning forward from perches and grabbing them off the twigs and leaves.

On October 6 I watched a flock of 30 for a half hour in the abandoned village of Kadena. They wheeled about between and over the banyan trees for long periods, taking up to 50 or more laps around the village, only to settle eventually in the same tree from which I had flushed them. Many times, as they approached the tree top in which they had been feeding on green berries, they would sail in as if preparing to land; but at a slight *churr* call note from one or more of them, the whole flock would pick up speed and go around again and again. I once heard a collision between birds in the closely spaced flock, but all kept on, apparently unhurt.

Birds in this flock which were without the reddish brown area on the lower throat and ear region were assumed to be immatures, as was the one bird seen on September 26. Such birds appeared to compose half or more of the flock.

Zosterops palpebrosus. Japanese White-eye. Common in all the "settled" areas of the island, around the villages and in scattered pine areas on the hills. I found them fairly common in August along the west coast north at least to Shana Wan and on August 30 along the east coast north at least to Kin. I counted 10 in a 2½-mile hike up the Bisha Gawa on September 10 and estimated that 20 were in trees along a half-mile stretch of the lower part of the same area on September 25. The largest flock actually counted was one of 16 birds on October 7 at Owan.

No songs were heard from any of these fall flocks, but songs were frequent through late May and June, especially in early morning and in the late afternoon.

Fully grown young begging food from adults were present in our camp as early as May 24. Two young, still with short tails, were being fed by adults on July 30. A nest, assumed to belong to this pair, was saddled on a small horizontal branch one foot out from the trunk and 12 feet up in the same pine tree in which the family was perched. The nest measured 4 inches in outside diameter by 2½ inches in total height, with inside cup 2¼ inches by 2¾ inches by 1½ inches deep. The base was composed of paper (1 piece nearly covering bottom), thin strips of birch-like bark, rootlets, and vine stems. A few small twigs were placed loosely in the outer ring. The lining was of dead pine needles, 3 inches long and pressed into the cup.

Passer montanus: Old World Tree Sparrow. This species very effectively filled the niche of the House Sparrow (*P. domesticus*), which was absent from Okinawa. They did, however, range well up into the pines on the hillsides and were not seen taking dust baths as the House Sparrow certainly would have been. I recorded them commonly on August 14 and 21 in all towns along the west coast north through Taira and less commonly between towns. Very few were found on September 26 and October 5 in the southern part of the island.

Several pairs about our camp apparently had nests inside the smokestack of the old sugar mill ruins; they went in and out through the bullet and shrapnel holes. They were frequently chased away from the top of the smokestack by the Red-bellied Rock Thrush which nested there. On June 6 I found a nest about 15 feet up on a horizontal branch of a pine along the lower Bisha Gawa. It was of globular form similar to tree nests of *P. domesticus* in California.

By July 4 Tree Sparrows were found widely in definite flocks of 10 to 12 birds each, containing both old and young. Those flocks fed extensively on the ripening rice and abundant insects in abandoned paddies along the river. By mid-September they had disappeared but small flocks were still frequent along dry roadsides and in abandoned sweet potato fields in the uplands.

Many of the call notes given by this species were similar to the chatterings of *P. domesticus* but usually less harsh. A note often repeated in flight is a more warbler-like *tchlip*, or even a musical *tzrink*.

Acknowledgments.—Grateful acknowledgment is made to Dr. Alden H. Miller, who was helpful in counsel and in making pertinent specimens and books at the Museum of Vertebrate Zoology available for study. Also I am indebted to the Bernice P. Bishop Museum in Honolulu for use of its library.

LITERATURE CITED

- Caldwell, H. R., and Caldwell, J. C.
1931. South China birds (Shanghai, Hester May Vanderburgh), xiv + 447 pp.
Hachisuka, M., et al.
1942. A hand-list of the Japanese birds. Third and revised edition (Ornithological Society of Japan), viii + 238 pp.
Kuroda, N.
1925. A contribution to the knowledge of the avifauna of the Riu Kiu Islands and the vicinity (Tokyo, published by the author), vi + 293 pp.
Mayr, E.
1945. Birds of the Southwest Pacific (New York, MacMillan Company), xx + 316 pp.
San Gabriel River Wildlife Sanctuary, El Monte, California, July 2, 1947.

ANALYSIS OF VARIATION IN WESTERN RACES OF THE WHITE-BREASTED NUTHATCH

By ALBERT C. HAWBECKER

This study has been undertaken to clarify the status and the ranges of the races of the White-breasted Nuthatch (*Sitta carolinensis*) which occur in the far western United States and Canada and in northern Lower California. Interest was directed toward the problem of racial differentiation in this species by the appearance of Aldrich's (1944) discussion of it. His conclusions concerning the races *nelsoni*, *aculeata*, *tenuissima*, and *alexandrae* were so at variance with those of Grinnell (1926) and Grinnell and Miller (1944:314) that further study seemed to be indicated.

Lack of material forbids the consideration of the entire range of *nelsoni* of the Rocky Mountain area, but the location of its western boundary is deemed pertinent to this investigation. The other three races are covered in their entirety although material is lacking from the northern portion of the range of *aculeata*.

The following persons loaned specimens under their care for this study: Mr. Laurence M. Huey, San Diego Society of Natural History; Dr. Robert T. Orr, California Academy of Sciences; and Mr. A. J. van Rossem, Donald R. Dickey Collections. I wish to express my thanks to them for their cooperation. The bulk of the specimens examined were in the Museum of Vertebrate Zoology where the study was carried on. Dr. Alden H. Miller gave freely of his time and experience in guiding me in this problem. Dr. Frank A. Pitelka offered many suggestions during the course of the study which added to its value. Mr. George C. Jensen assisted in checking the statistics and did the drafting on the maps and charts.

REVIEW OF CLASSIFICATION

The first White-breasted Nuthatch described from the Pacific coast area was *aculeata*, named by Cassin (1856:255) from specimens collected by Gambel (1846:112). Grinnell (1932) fixed the type locality as Monterey, California. Mearns (1902) described the race *nelsoni* from the Huachuca Mountains of southern Arizona. Grinnell (1918) described the race *tenuissima* from the Panamint and White mountains of east-central California. Grinnell (1926) also described the race *alexandrae* from the Sierra San Pedro Mártir of northern Lower California. The ranges of these races were not fully indicated at the times of their description. Grinnell and Miller in 1944 outlined the ranges of the races thought to inhabit California. Aldrich (1944) using a large number of specimens outlined, for the first time, the ranges of all races of the species. He indicated extensive changes in ranges in the far west compared with the previously accepted picture of distribution. These changes involved reduction of *alexandrae* to the synonymy of *tenuissima*; this was justified by placing the birds of southern California with the latter race, whereas previously they had been considered a part of *aculeata*. He believed that the size of southern California birds linked them more closely with the larger race, *tenuissima*, than with the smaller race, *aculeata*. Furthermore, he failed to detect significant differences between *tenuissima* and *alexandrae*.

While Aldrich's paper has resulted in a much better understanding of the ranges of the races in general, careful examination of specimens reveals that the status of *alexandrae* and of the adjacent portions of the ranges of *aculeata* and *tenuissima* are not properly shown by his work. His extension of the range of *tenuissima* to include northeastern California, eastern Oregon, and eastern British Columbia seems quite justifiable. Aldrich did not examine specimens of *nelsoni* from eastern Nevada but based his extension of its range into this area on Linsdale's (1936:89) work.

The crux of the most important problem, the status of the southern California birds, lies in the identification of the size gradient of which they are a part—the one involved in *aculeata* or the one involved in *tenuissima*.

METHODS

In the course of my work 613 birds from the Pacific coast and Rocky Mountains were examined and measured. The measurements taken from most of the specimens were length of closed wing, length of tail, length of bill from nostril, length of tarsus, and length of middle toe. These measurements followed specifications laid down by Baldwin, Oberholser, and Worley (1931). As measuring progressed some attempt was made to evaluate the accuracy and reliability of methods and the results obtained. Wing length and length of bill appeared to be the most reliable measurements and showed the least error when retaken and the least variation due to make of skin. The act of measuring the tail and tarsus left something to the judgment of the measurer, but every effort was made to standardize these measurements. The other measurements were discarded as unreliable. It is probable that the greatest reliance should be placed on statistics obtained from measurements of wing length and bill length.

An attempt was made to find a visual means of distinguishing birds of the year from adults, but without success. In the early summer adults can be distinguished by their worn flight feathers but after their late summer molt it is impossible to tell adults and immatures by means of plumage. Measurements of birds of known ages, so labeled by competent collectors who had examined skull structure, were made to find possible size variations due to age. It was soon apparent that birds labeled "juvenile" had bills that were much shorter either than those labeled "adult," or than those of late summer birds which are often labeled "immature." Other measurements of juveniles closely approximated those of adults. These facts showed that as long as juvenile birds were not used in statistical analysis, age made little difference in the final figures.

An attempt was made to find constant color variations within the races so that color might enter into the consideration. It was found, however, that the plumage of birds even within the same area wore unevenly and that the amount of wear made a significant difference in the shade of color. The wings and undersides of breeding birds in particular showed a great deal of variation in amount of wear. If it were possible to have a good series of fall birds from each area, significant color differences could probably be readily determined. Disagreement between Aldrich and Grinnell on variations in color, particularly in the race *alexandrae*, suggested that such variables in these races are largely a matter of personal evaluation. All the aforementioned factors seemed to indicate that minute variations in shades and amounts of color could not be safely used as criteria for distinguishing these races.

Grinnell and Miller (1944:314) state that these nuthatches are resident but that there is movement up and down slopes as well as some fall wandering. Some evidence of such activity is apparent as a result of this study also. It appears, however, that there is not sufficient migration into the area occupied by another race to cloud the picture as far as that race is concerned; thus adults of all seasons were used in the computations.

All birds known to be immature, significantly worn, or molting were eliminated from statistical consideration.

Specimens examined.—Specimens in the Dickey Collections are designated "DC," those in the San Diego Museum of Natural History as "SDM" and those in the California Academy of Sciences, "CAS." All other specimens are in the Museum of Vertebrate Zoology, University of California.

British Columbia. Okanagan, 2 (DC) 9; Okanagan Landing, 1; Kootenay, 2 (DC); East Kootenay, 1.

Washington. PIERCE CO.: Tacoma, 1.

Oregon. JACKSON CO.: Eagle Point, 2. DESCHUTES CO.: 11 mi. W Bend, 1; 3 mi. W Paulina Lake, 2; 7 mi. NW Sisters, 6. WHEELER CO.: 11 mi. W, 7 mi. S Mitchell, 10. COOK CO.: Grizzly Mt., 2; Ochoco Ranger Sta., 1. GRANT CO.: 12 mi. S Canyon City, 3; 21 mi. SE Prairie City, 12. CLACKAMAS CO.: Mulino, 1 (DC).

California. SISKIYOU CO.: Bray, 2 (CAS); Seiad Valley P.O., 3; Scott River, 2; Park Creek, 1. MODOC CO.: 12 mi. SW Eagleville, 1 (CAS); Jess Valley, 1 (CAS); Patterson Mill, 1 (CAS); Head North Fork Parker Creek, 2; Head Pine Creek, 1; E face Warner Pk., 2. LASSEN CO.: Bogard Ranger Sta., 1 (CAS); Eagle Lake, 1; 3 mi. W Susanville, 5. TRINITY CO.: Hayfork, 1; 8 mi. NE Hyampom, 1; 1 mi. W Hyampom, 1; 4 mi. N Mad River Rock, 2; Reilley's Ranch, 10; Norse Butte, 1; 5 mi. S. King, 1. TEHAMA CO.: 1 mi. NE Red Bluff, 3; 2 mi. NE Tehama, 2; 2 mi. SE Beegum, 1; Payne Creek P.O., 10; Inskip Hill, 1; 2 mi. W Black Butte, 2. MENDOCINO CO.: Sanhedrin Mt., 1; Sherwood, 1. BUTTE CO.: 4 mi. SE Chico, 3; 10 mi. SW Chico, 3; 4 mi. N Oroville, 1. SIERRA CO.: Sierra City, 1 (DC) 1 (CAS). NEVADA CO.: Grass Valley, 2; Independence Lake, 2; Penn Valley, 1. LAKE CO.: 3 mi. N Upper Lake, 1. PLACER CO.: Cisco, 4; Applegate, 1 (CAS). EL DORADO CO.: Lake Audrain, 3 (DC); "Eldorado County," 2. ALPINE CO.: 4 mi. W Lookout Pk., 1. SAN JOAQUIN CO.: Tracy, 1. MONO CO.: Mono Mills, 3; Eva Bella Mine, 1; Prospector Meadow, 7; SW Benton, 3; NW Benton, 6; 5 mi. W Benton, 5; 4 mi. NE Benton, 2; 9 mi. W Benton, 2; 5 mi. E Mono Mills, 2; Cottonwood Creek, 1. ALAMEDA CO.: Arroyo Mocho, 6; Cedar Mt., 2. CONTRA COSTA CO.: Mt. Diablo, 1; Lafayette, 1. MARIPOSA CO.: Dudley, 10; Echo Creek, 1; Mono Meadow, 1; 2 mi. NW Pleasant Valley, 1. STANISLAUS CO.: 3 mi. N LaGrange, 2; 1 mi. SW LaGrange, 1. MERCED CO.: 1 mi. S Merced Falls, 1. SANTA CLARA CO.: 2 mi. E Mt. Hamilton, 1. MADERA CO.: Raymond, 1. SAN BENITO CO.: 5 mi. NE San Benito, 4; San Benito Mt., 3; 4 mi. S Hernandez, 7; 6 mi. SE San Benito, 6; 4 mi. NW Pinnacles P.O., 1; Mulberry, 1 (DC). MONTEREY CO.: Jolon, 7; Abbot Ranch, 3; Santa Lucia Pk., 3; 9 mi. W Jamesburg, 1; Peachtree Valley, 1; San Lucas, 1. FRESNO CO.: Bubbs Creek, 1; Hume, 1; Waltham Creek, 1. INYO CO.: Cedar Flat, 1; Cottonwood Lake, 5; SW Big Pine, 3; White Mts., 1; 7 mi. E Laws, 3; Poison Creek, 4; 3 mi. E Jackass Spring, 1; E base Waucoba Mts., 1; Wyman Creek, 2 (DC) 1. TULARE CO.: Whitney Creek, 1; Whitney Meadow, 4; Olancha Pk., 1; Jackass Meadow, 2; Trout Creek, 3; Siretta Meadows, 1; Cannell Meadows, 2; Long Meadow, 1; Taylor Meadow, 3; Little Lake, 1; Smith Meadow, 1; Golden Trout Creek, 1; 1 mi. S Aukland, 1. KERN CO.: Ft. Tejon, 1; 8 mi. W Isabella, 2; 12 mi. W Bodfish, 3; French Gulch, 3; Thompson Canyon, 2; Walker Basin, 3; Buena Vista Lake, 1 (DC); 14 mi. W, 6 mi. N McKittrick, 1. SAN LUIS OBISPO CO.: San Miguel, 1; Cambria, 1; Santa Margarita, 2; Cammatti Creek, 10; 5 mi. E, 4 mi. S Shandon, 1; 3 mi. E McChesney Mt., 2; McChesney Mt., 1. SANTA BARBARA CO.: Santa Cruz Island, 1 (DC). VENTURA CO.: Mt. Pinos, 3 (DC). LOS ANGELES CO.: Newhall, 1; Pasadena, 2; San Antonio Canyon, 1; Mt. Wilson, 5 (CAS) 8; Chilo, 1; Buckhorn, 2; Mint Canyon, 1. SAN BERNARDINO CO.: Victorville, 4 (CAS); Bluff Lake, 5 (SDM) 1; Hog Canyon, 1; Sugarloaf, 1; Santa Ana, 8; San Bernardino Mts., 4 (SDM) 2; San Servain Flats, 1 (DC); Oak Glenn, 6 (DC); Big Bear Valley, 1 (DC); Barstow, 1; Fish Creek, 1. RIVERSIDE CO.: Fuller's Mill, 3; Hidden Lake, 1; Tahquitz Valley, 1; Strawberry Valley, 2; Garnet Queen Mine, 6; Thomas Mt., 1; Schain's Ranch, 4; San Jacinto Mts., 5 (DC) 2 (SDM); Round Valley, 1; Riverside, 3. SAN DIEGO CO.: Witch Creek, 2 (CAS) 1 (SDM) 2; Volcan Mts., 3 (CAS) 4; Julian, 1 (DC) 2; Cuyumaca Mts., 2 (DC) 2 (SDM) 5; Laguna Mts., 1 (SDM); Descanso, 1 (DC); 15 mi. N San Diego, 1.

Nevada. WASHOE CO.: Incline, 6; Galena Creek, 7. LANDER CO.: Mahogany Canyon, 2; Bunker Hill, 2; E Kingston Ranger Sta., 2; Ridge W Kingston Ranger Sta., 1. WHITE PINE CO.: Lehman Creek, 4; Baker Creek, 1. ESMEERALDA CO.: Pinchot Creek, 1; Pine Grove, 3. NYE CO.: Grapevine Pk., 4; Burned Corral Canyon, 4; CLARK CO.: Potosi Mt., 1; Lee Canyon, 4 (DC); Hidden Forest, 2 (DC); St. Thomas, 1 (DC). LINCOLN CO.: Mt. Irish, 2.

Arizona. COCONINO CO.: Mormon Lake, 1; San Francisco Pk., 2; 8 mi. SE Flagstaff, 1. MOHAVE CO.: Mt. Trumbull, 1. YUMA CO.: Alamo, 1 (DC). GILA CO.: Carr's Ranch, 3; Mazatzal Pk., 1. PIMA CO.: Soldier Camp Sta., 1; Fort Lowell, 2; E slope Baboquivari Mts., 2 (DC); Madera Canyon, 1; Rincon Mt., 1 (CAS). SANTA CRUZ CO.: Pena Blanca Spring, 3 (DC) 3; Yank Spring, 8 (DC); Int. Boundary Mon. 31, 1 (DC); Tumacacori Mission, 1 (DC); 4 mi. S Patagonia, 1 (CAS); 7 mi. N Patagonia, 2 (CAS); 3 mi. SW Patagonia, 1 (CAS). COCHISE CO.: Chiricahua Mts., 3; Huachuca Mts., 2 (DC) 4 (CAS); Paradise, 2 (CAS).

Wyoming. SUBLETTE CO.: Green River Lakes, 3.

Utah. SAN JUAN CO.: Navajo Mt., 1.

Colorado. EL PASO CO.: 10 mi. N Colorado Springs, 2. DENVER CO.: Denver, 1.

Manitoba. Gimli, 1.

Lower California. Laguna Hanson, 8; La Grulla, 12; Vallecitos, 10.

Localities of materials used for comparison only.—Lower California. Laguna Valley, 12; El Sauz, 13.

Sinaloa. Pinos Gordo, 1 (CAS).

Chihuahua. La Union, 1.

GEOGRAPHIC VARIATION

After some trial segregation the birds were divided into five populations within each of which there was no important geographic variation. These groups were based on the dimensions of the birds. The five groups occupy the following geographic areas: northern and central California between the Sierra Nevada-Cascade chain and the humid coastal strip; southern California from Los Angeles to San Diego counties; Sierra San Pedro Mártir of Lower California; eastern California and western Nevada; and the Rocky Mountain area of Arizona. Excluded from these populations were birds from known intergradational areas and such small groups as those of east-central Oregon and the Sierra Juárez of Lower California. The plan was to derive statistics for birds of these areas without influence of intergradient or isolated populations.

Study of table 1 and figures 7 and 8 shows the gradual increase in measurements of the variables from north to south in the coastal groups and those immediately adjacent on the east. It can be seen that at any equivalent latitude the interior group is significantly larger than the coastal one. Greatest measurements for the interior populations are found in the southern Sierra Nevada and adjacent ranges. The coastal populations increase gradually, but not uniformly, in size until southern San Diego county is reached and from there the increase in size is sharply upward culminating in a large-sized group in the Sierra San Pedro Mártir. The birds in the Sierra Juárez of Lower California, although much larger generally than those of adjacent San Diego County, are still more closely allied to them in measurements than to the Sierra San Pedro Mártir population. The extremes of the Sierra Juárez group slightly overlap those of the two adjacent populations.

In comparing specimens from southern California it is found that although they are significantly larger than the coastal population immediately to the north, they are also significantly smaller than those from the interior. Thus the population from southern California does not fit in as a clinal link between the large-dimensioned interior population and the equally large or larger birds found in the Sierra San Pedro Mártir. A careful study of the range of the coastal groups shows that specimens are rarely taken above the Transition Zone, that is, above the pine-oak associations that are found on the west slope of the Sierra Nevada and westward. A similar study of the interior population shows that specimens are seldom taken below the Canadian Zone, that is, the lodgepole pine association. If habitat conditions characteristic of this plant belt are necessary for birds of this group, they would not be expected to be present in southern California where such habitat is limited.

It is believed that the population of southern California is subject to two influences. It is not improbable that pioneers from the interior population reach this area as they are found on peaks in Nevada widely separated by areas of a much lower life-zone. Fall birds have been taken from the San Bernardino Mountains that resemble the interior group more than this southern one. It seems very possible that birds from the northern coastal group by infiltration influence the characters of the group of southern California as specimens closely approximating the northern group have been taken in southern California also. Due to similarity in habitat and easier access it seems that the northern coastal group may have the greatest influence. Some winter birds taken in San Diego County are quite large which might be indicative of influence from the Sierra San Pedro Mártir. There is no evidence other than this, however, of that possibility.

Not enough specimens are available to study gradients in the Rocky Mountain population. Among the three populations, coastal, interior, and Rocky Mountain, it can be seen that wing length increases from west to east, but other variables do not correlate with this.

Table 1
Statistical Comparisons of Means of Populations

	No.	Males Mean	σ	σM	d/σ_d
Wing					
No. Calif.	54	84.55	1.74	0.23	4.40
So. Calif.	36	86.18	1.75	0.29	6.44
Lo. Calif.	14	89.72	1.88	0.50	1.62
Interior	35	88.72	2.05	0.34	2.94
Arizona	21	90.22	1.63	0.35	
Tail					
No. Calif.	54	45.02	1.57	0.21	3.16
So. Calif.	35	46.16	1.83	0.30	7.67
Lo. Calif.	14	50.15	1.38	0.36	2.76
Interior	38	48.50	2.01	0.32	2.64
Arizona	19	47.23	1.09	0.25	
Bill					
No. Calif.	52	14.80	0.59	0.08	6.78
So. Calif.	34	15.75	0.63	0.10	8.95
Lo. Calif.	11	17.72	0.77	0.23	5.81
Interior	34	16.44	0.67	0.11	8.20
Arizona	21	15.03	0.70	0.15	
Tarsus					
No. Calif.	51	17.34	0.46	0.06	1.14
So. Calif.	8	17.18	0.45	0.15	3.85
Lo. Calif.	12	17.95	0.46	0.13	3.52
Interior	28	17.35	0.57	0.10	0.37
Arizona	5	17.26	0.42	0.18	

Characters of size of the major populations are clear and unmistakable as can be seen by referring to figures 7 and 8. The coastal one is the smallest in all respects. The San Pedro Mártir group has the longest bill of all and a much longer wing than the coastal group to the north. The wing and bill of the interior population are longer than those of the coastal one whereas the wing is shorter but the bill longer than those of the Arizona specimens. Using these characters it is possible to designate the races and to recognize possible intergrades.

On the basis of the foregoing account the following available names are applied to the originally mentioned populations. Two groups, the one from northern coastal California and the one from southern California, can be designated as *aculeata*. The interior group is designated as *tenuissima* and the Sierra San Pedro Mártir population as *alexandrae*. It might be argued that if this latter named population is the end of the coastal cline, the groups of large-sized and small-sized birds at opposite ends of the interior cline within *tenuissima* should also each be recognized by a race name. However, the

Table 1 (continued)
Statistical Comparisons of Means of Populations

	No.	Females Mean	σ	σM	d/σ_d
Wing					
No. Calif.	21	82.94	1.12	0.24	3.14
So. Calif.	18	84.42	1.64	0.38	5.26
Lo. Calif.	8	88.21	1.89	0.67	0.95
Interior	19	87.31	2.40	0.55	2.55
Arizona	17	89.12	1.85	0.44	
Tail					
No. Calif.	19	44.28	1.43	0.32	2.27
So. Calif.	18	45.51	1.88	0.44	4.85
Lo. Calif.	7	49.15	1.14	0.43	1.58
Interior	20	48.23	1.42	0.31	1.62
Arizona	17	47.50	1.41	0.34	
Bill					
No. Calif.	25	14.29	0.46	0.09	5.11
So. Calif.	24	15.16	0.81	0.16	6.67
Lo. Calif.	8	17.03	0.44	0.15	3.12
Interior	17	16.28	0.68	0.16	7.88
Arizona	15	14.94	0.51	0.13	
Tarsus					
No. Calif.	19	17.32	0.43	0.09	0.11
So. Calif.	10	17.30	0.62	0.19	2.50
Lo. Calif.	7	17.95	0.37	0.14	4.57
Interior	17	17.31	0.37	0.08	0.64
Arizona	5	17.40	0.14	0.06	

Where d/σ_d is 2.50 or more the difference between the means is probably significant and where it is 3.00 or more the difference is surely significant. Formulae for statistical analysis from Simpson and Roe (1939).

Values for d/σ_d between southern Californian and interior populations are as follows: Males—wing, 5.64; tail, 5.20; bill, 4.92; tarsus, 0.85. Females—wing, 4.31; tail, 5.23; bill, 5.09; tarsus, 0.05.

southward increase in the gradient in the interior, although especially marked in the wing, occurs over a long distance whereas the increase in size from *aculeata* to *alexandrae* is very great and occurs over a short distance. The population in southern California might also be considered a separate race as it is significantly different from the adjacent populations. However, it fits in well with the gradient for size as exhibited by the rest of the race *aculeata* and should for practical reasons of classification be contained within that group. It would be possible to pick small groups out of the populations of either *aculeata* or *tenuissima* and compare them with other small groups much farther north or south in the same population and find small average differences. If the population is studied as a whole, however, relationships and trends in size which tie the members of a group together become apparent.

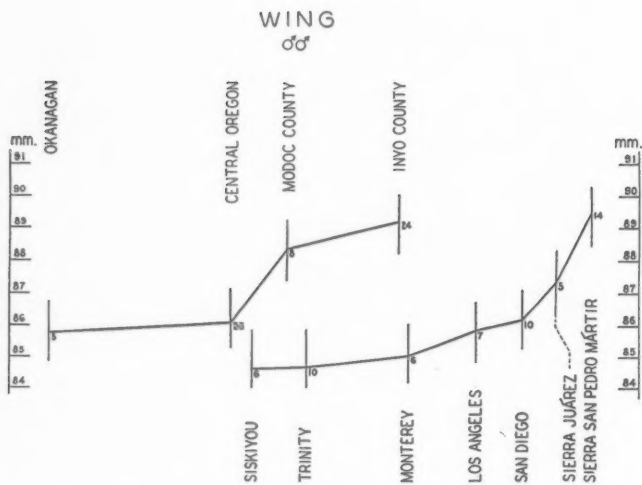


Fig. 7. Clines for wing length in populations of White-breasted Nuthatches. Lines connect averages; vertical bars indicate range; numbers by cross bars indicate number of specimens.

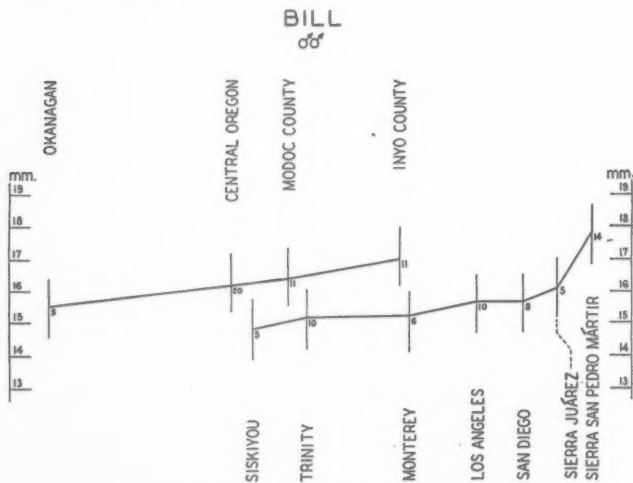


Fig. 8. Clines for bill length in populations of White-breasted Nuthatches. Lines connect averages; vertical bars indicate range; numbers by cross bars indicate number of specimens.

RACES

Sitta carolinensis nelsoni Mearns

Sitta aculeata, Baird (1858:375), part; Coues (1866:78).

Sitta carolinensis aculeata, Allen (1872:161); Coues (1872:83), part; Coues (1874:24), part.

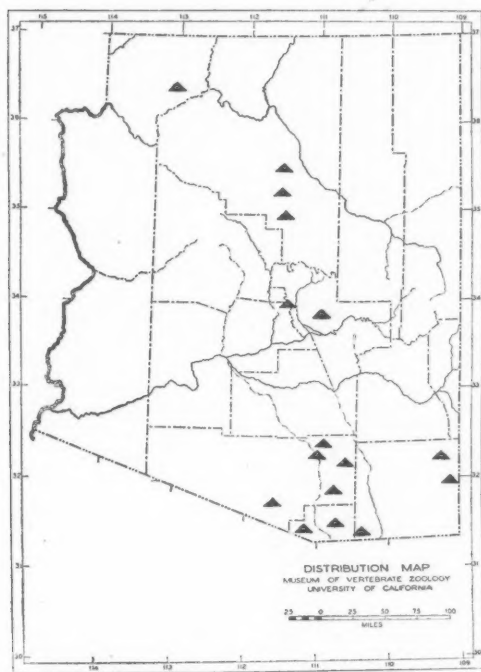


Fig. 9. Distribution of *Sitta carolinensis nelsoni* in Arizona. Triangles indicate localities from which specimens have been examined.

Sitta carolinensis nelsoni Mearns (1902:923), original description, type locality, Huachuca Mountains, Arizona; Ridgway (1904:447), part; Hellmayr (1934:94), part; Linsdale (1936:89); van Rossem (1936:37); Aldrich (1944:94).

Subspecific characters.—The wing of this race averages the longest of the western races. Both the bill and the tail average shorter, the bill extremely so, than those of *tenuissima*, its nearest neighbor on the west.

Measurements.—Specimens from Arizona.

	No.	Range	Mean	σ	V
Wing					
Males	21	87.2-94.0	90.22 \pm 0.35	1.63	1.80 \pm 0.29
Females	17	84.6-92.8	89.12 \pm 0.44	1.85	2.07 \pm 0.35
Tail					
Males	19	44.8-48.8	47.23 \pm 0.25	1.09	2.30 \pm 0.37
Females	17	45.3-50.6	47.50 \pm 0.34	1.41	2.96 \pm 0.50
Bill					
Males	21	13.3-16.5	15.03 \pm 0.15	0.70	4.65 \pm 0.71
Females	15	13.9-15.6	14.94 \pm 0.13	0.51	3.34 \pm 0.51
Tarsus					
Males	5	16.7-17.9	17.25 \pm 0.18	0.42	2.43 \pm 0.76
Females	5	17.2-17.6	17.40 \pm 0.06	0.14	0.80 \pm 0.11

In the present study interest in the distribution of this race is concerned only with Nevada and California. Some breeding birds of the Toyabe Mountains of central Ne-

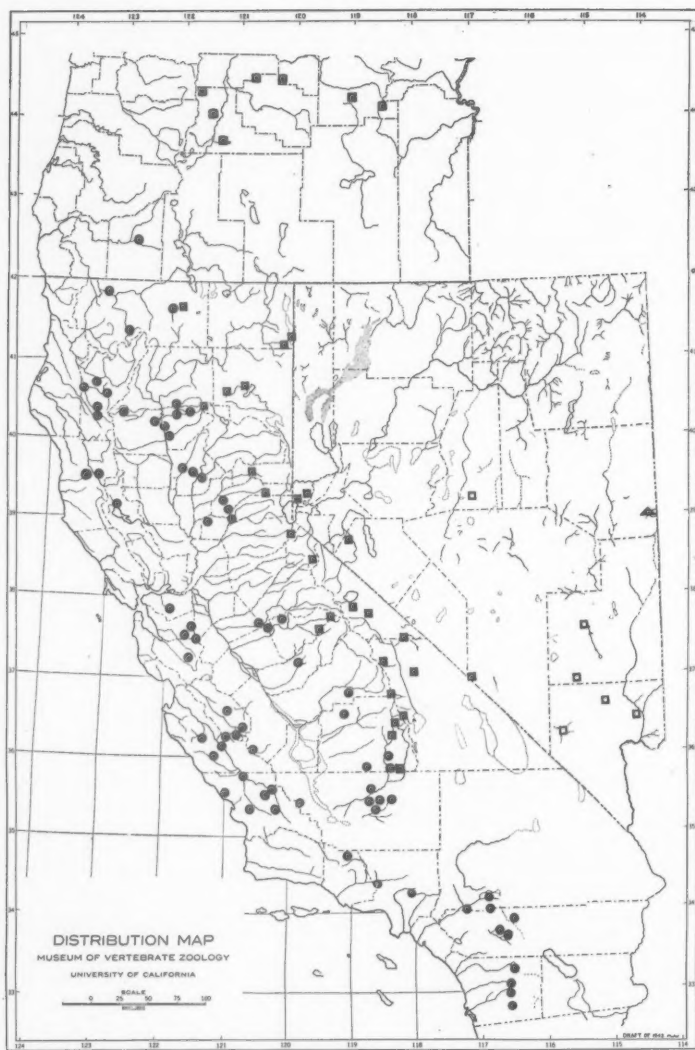


Fig. 10. Distribution of races of *Sitta carolinensis* in Oregon, Nevada and California. Symbols indicate localities from which specimens have been examined. Triangles, *S. c. nelsoni*; solid squares, *S. c. tenuissima*; open squares, intergrades between *nelsoni* and *tenuissima*; dots, *S. c. aculeata*.

vada are of wing and bill length that would relate them to *nelsoni*. In this same range other breeding birds closely approximate *tenuissima* in size. Birds were taken in south-eastern Nevada on Mount Irish in September, some of which conform to *nelsoni* in size

and some to *tenuissima*. Fall birds from the Charleston Mountains in extreme south-eastern Nevada conform closely to *nelsoni* in size, which would confirm van Rossem's (1936:37) identification of them. An October-taken bird from Alamo, Yuma County, Arizona, might be considered intermediate, but seems more nearly related to *nelsoni* on the basis of bill length. This bird is probably a fall wanderer. Specimens from eastern White Pine County, Nevada, are typically *nelsoni*. There appears to be a broad zone of intergradation in the mountains of central to eastern Nevada, and there is also probably wandering of non-breeding *tenuissima* eastward, and of *nelsoni* westward. By comparing measurements shown in figures 7 and 8 and table 1, it can be seen that specimens from northeastern California conform more closely in size with *tenuissima* than with *nelsoni*, although there is a single, winter-taken specimen from that locality that resembles *nelsoni*.

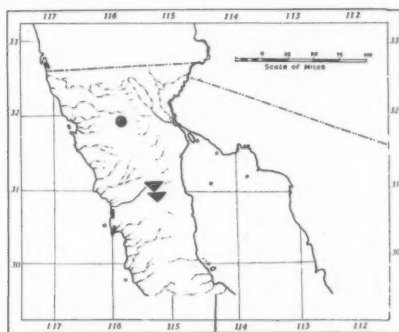


Fig. 11. Distribution of *Sitta carolinensis* in northern Lower California. Symbols indicate localities from which specimens have been examined. Dot, *S. c. aculeata*; inverted triangles, *S. c. alexandrae*.

Sitta carolinensis aculeata Cassin

Sitta aculeata Cassin (1856:254), original description, type locality, Monterey, California; see Grinnell (1932:290); Baird (1858:374), part.

Sitta carolinensis aculeata, Baird, Brewer, and Ridgway (1874:117), part; Dawson (1923:638); Grinnell (1929:219); Hellmayr (1934:94); Grinnell and Miller (1944:315), part; Aldrich (1944:594), part.

Subspecific characters.—This race averages the smallest, in all variables, of the races under consideration. It is closest to *nelsoni* in bill length, but its wing length does not approach that of any of the other races.

Measurements.—Specimens from northern and central California west of the Sierra Nevada have been used. Measurements for birds from southern California may be found in table 1.

	No.	Range	Mean	σ	V
Wing					
Males	54	80.2-89.8	84.55 \pm 0.32	1.74	2.05 \pm 0.18
Females	21	80.7-84.8	82.94 \pm 0.24	1.12	1.35 \pm 0.28
Tail					
Males	54	41.2-48.7	45.02 \pm 0.21	1.57	3.48 \pm 0.33
Females	19	42.0-47.5	44.28 \pm 0.32	1.43	3.22 \pm 0.52
Bill					
Males	52	13.3-16.6	14.80 \pm 0.08	0.59	3.98 \pm 0.39
Females	17	13.3-15.1	14.25 \pm 0.09	0.46	3.22 \pm 0.55
Tarsus					
Males	51	16.3-18.7	17.34 \pm 0.06	0.46	2.64 \pm 0.26
Females	19	16.4-18.2	17.32 \pm 0.10	0.43	2.47 \pm 0.40

Specimens from the extreme northern part of the range are few, but the range appears to be from Puget Sound, Washington, south to the Sierra Juárez, Lower California, and from the western slopes of the Sierra Nevada and Cascade Mountains, to, but generally not including, the coastal humid belt. This population seems to be more of a lowland type with birds generally occurring in oaks or ponderosa pine, although there are occasional specimens that have been taken in lodgepole pine. It appears that this race is separated from *tenuissima* by the heavy fir forest belt of the Sierra Nevada-Cascade chain. The only places where there is some evidence of intergradation is in northeastern California where topographic conditions are favorable for intermingling, and in southern California where there is some habitat favorable to *tenuissima* as well as *aculeata*. Birds found in the passes of the Sierra Nevada, such as at Cisco, Placer County, and farther south in Tulare County, more nearly approximate *tenuissima*, although the two races appear to be but slightly separated at such points. Birds from farther south along the Kern River and in the Walker Basin closely resemble *aculeata*. Specimens from southern California, even at higher elevations, are almost all significantly smaller than *tenuissima*. Winter birds taken from Victorville, San Bernardino County, have a longer bill resembling *tenuissima*, but the wing length is average for *aculeata*. Specimens from the Sierra Juárez, Lower California, although greater in dimensions than typical *aculeata*, are somewhat closer in average measurements to that race than to *alexandrae* on the south.

Sitta carolinensis tenuissima Grinnell

Sitta aculeata, Baird (1858:375), part.

Sitta carolinensis aculeata, Coues (1872:83), part; Coues (1874:24), part; Baird, Brewer, and Ridgway (1874:117), part; Brooks and Swarth (1925:114).

Sitta carolinensis nelsoni, Ridgway (1904:447), part; Grinnell, Dixon, and Linsdale (1930:319); Grinnell and Miller (1944:314).

Sitta carolinensis tenuissima Grinnell (1918:88), original description, type locality, Hanaupah Canyon, 8700 feet., Panamint Mountains, Inyo County, California; Dawson (1923:642); Hellmayr (1934:95); Linsdale (1936:89); van Rossem (1936:37); Grinnell and Miller (1944:317); Aldrich (1944:595), part.

Subspecific characters.—The wing and the bill of this race average much longer than those of *aculeata*, as can be seen in figures 7 and 8. The wing of *tenuissima* is shorter on the average than in *nelsoni*, but the bill is longer. Except for bill length *tenuissima* compares favorably in measurements with *alexandrae*, from which it is separated geographically by *aculeata*.

Measurements.—Specimens from east-central California and west-central Nevada.

	No.	Range	Mean	σ	V
Wing					
Males	35	83.3-93.2	88.72 \pm 0.34	2.05	2.31 \pm 0.27
Females	19	82.2-91.3	87.31 \pm 0.55	2.40	2.74 \pm 0.44
Tail					
Males	38	44.5-51.9	48.50 \pm 0.32	2.01	4.14 \pm 0.47
Females	20	45.3-50.6	48.23 \pm 0.31	1.42	2.94 \pm 0.46
Bill					
Males	34	14.5-17.6	16.44 \pm 0.11	0.67	4.08 \pm 0.49
Females	17	15.3-17.0	16.28 \pm 0.16	0.68	4.17 \pm 0.71
Tarsus					
Males	28	16.4-18.5	17.35 \pm 0.10	0.57	3.28 \pm 0.43
Females	17	15.3-17.0	17.31 \pm 0.08	0.37	2.13 \pm 0.36

This race ranges from southern British Columbia to east-central California and southern Nevada, and from central Nevada, where it appears to intergrade with *nelsoni*, to open wooded portions of the high Sierra Nevada and Cascade Mountains, but not across them. There is some evidence of intergradation with *aculeata* in northeastern California, and *aculeata* seems to wander into that area in the winter. There is little

evidence of intergradation with *aculeata* in the passes of the Sierra Nevada, but this seems possible. The great majority of the specimens assignable to this race have been taken in the Canadian and Hudsonian life-zones, usually in the more open pine stands. According to Brooks and Swarth (1925:114), however, those of the interior of southern British Columbia are found in ponderosa pine, which is regarded as Transition Life-zone. The specimens from this locality conformed more closely to *tenuissima* in dimensions than they did to *aculeata* to which race they had been assigned until Aldrich (1944) shifted them. This race apparently does not extend (except for possible winter wanderers) into the mountains of southern California, possibly due to the scarcity of suitable nesting grounds. As shown in figure 7 this race is the smallest in southern Canada and reaches its greatest size in the southern Sierra Nevada and adjacent mountains.

Sitta carolinensis alexandrae Grinnell

Sitta carolinensis aculeata, Anthony (1893:246); Ridgway (1904:444), part.

Sitta carolinensis alexandrae Grinnell (1926:405), original description, type locality, near Arroyo La Encantada, 7200 ft., 3 miles north of La Grulla, Sierra San Pedro Mártir, Lower California, Mexico; Grinnell (1928:220); Hellmayr (1934:95).

Sitta carolinensis tenuissima, Aldrich (1944:596), part.

Subspecific characters.—The bill of this race averages much the longest of any of the races under consideration. All measurements average far more than those of *aculeata*, the nearest neighbor, and than those of the race *lagunae* of the Cape district of Lower California.

Measurements.—Specimens from La Grulla and Vallecitos in the Sierra San Pedro Mártir only.

	No.	Range	Mean	σ	V
Wing					
Males	14	86.7-93.9	89.72±0.50	1.88	2.09±0.39
Females	8	84.3-90.7	88.21±0.67	1.89	2.14±0.53
Tail					
Males	14	47.8-52.7	50.15±0.36	1.38	2.75±0.51
Females	7	48.1-51.0	49.15±0.43	1.14	2.31±0.61
Bill					
Males	11	16.5-18.9	17.72±0.23	0.77	4.34±0.92
Females	8	16.4-17.9	17.03±0.14	0.44	2.58±0.64
Tarsus					
Males	12	16.9-18.6	17.95±0.13	0.46	2.56±0.52
Females	7	17.2-18.3	17.95±0.14	0.37	2.06±0.55

Known from the Sierra San Pedro Mártir only. Specimens from the Sierra Juárez to the north are larger than *aculeata* of San Diego County, but still average shorter in all variables than *alexandrae*, whereas, the aforementioned *lagunae* is also smaller in all respects. This would then limit this race to the Sierra San Pedro Mártir.

SUMMARY

Four distinct races of the White-breasted Nuthatch are present in the western United States and adjacent portions of Canada and Lower California.

The race *nelsoni* is the longest-winged race and reaches its western limit in the mountains of eastern Nevada. It intergrades with *tenuissima* as far west as central Nevada. Except for possible winter wanderers there is but little evidence that *nelsoni* ever reaches northeastern California, a point already made by Aldrich (1944).

The race *aculeata* averages the smallest in all respects and is found west of the Sierra Nevada-Cascade chain, but east of the humid coastal belt. It is seldom found above the Transition Life-zone. This race, as herein conceived, includes the group of birds from southern California.

The race *tenuissima* averages larger than *aculeata* and is longer-billed but shorter-winged than *nelsoni*. Its range is from southern British Columbia to the southern Sierra Nevada and adjacent ranges. It intergrades with *nelsoni* from central to eastern Nevada

and ranges westward to the Canadian and Hudsonian life-zones of the Sierra Nevada-Cascade Mountain system.

The race *alexandrae* is, except in wing length, the largest race, being approached only by *tenuissima* from which it is separated by *aculeata* of southern California. It is found in the Sierra San Pedro Mártir and may range northward toward the Sierra Juárez, although there is no specimen from there equal to this race in bill length.

As pointed out by Aldrich (1944) there is a general increase in size from north to south in both *aculeata* and *tenuissima*. Contrary to his findings, however, it was found that the population of southern California is significantly smaller than that of *tenuissima*. It is more closely linked to the cline represented in *aculeata*. Thus the gradient in *tenuissima* reaches its greatest extent in the high levels of the southern Sierra Nevada and adjacent mountains, rather than in the Sierra San Pedro Mártir. The gradient in *aculeata* takes an abrupt turn upward toward its southern extreme and culminates in the terminal race, *alexandrae*.

LITERATURE CITED

- Aldrich, J. W.
1944. Notes on the races of the white-breasted nuthatch. *Auk*, 61:592-604.
- Allen, J. A.
1872. Notes of an ornithological reconnaissance of portions of Kansas, Colorado, Wyoming, and Utah. *Bull. Mus. Comp. Zool.*, 3:113-183.
- Anthony, A. W.
1893. Birds of San Pedro Mártir, Lower California. *Zoe*, 4:228-247.
- Baird, S. F.
1858. Birds. *Pac. R. R. Repts.*, 9:1vi + 1005.
- Baird, S. F., Brewer, T. M., and Ridgway, R.
1874. History of North American birds (Boston, Little, Brown and Co.), 1:xxvii + 596 + vi.
- Baldwin, S. P., Oberholser, H. C., and Worley, L. G.
1931. Measurements of birds. *Sci. Publ. Cleveland Mus. Nat. Hist.*, 2:ix + 165.
- Brooks, A., and Swarth, H. S.
1925. A distributional list of the birds of British Columbia. *Pac. Coast Avif. No.* 17:1-158.
- Cassin, J.
1856. Descriptions and notes on birds in the collection of the Academy of Natural Sciences of Philadelphia, and in the National Museum, Washington. *Proc. Acad. Nat. Sci. Phila.*, 3:254-255.
- Coues, E.
1866. Ornithology of the Arizona territory. *Proc. Acad. Nat. Sci. Phila.*, 1866:39-100.
1872. Key to North American birds (New York, Dodd and Mead; Boston, Estes and Lauriat), viii + 361.
1874. Birds of the northwest. *U. S. Geol. Surv. Misc. Publ.*, 3:xi + 791.
- Dawson, W. L.
1923. The birds of California. Booklovers' ed. (San Diego, Los Angeles, San Francisco: South Moulton Co.), 2:xi + 523-1034.
- Gambel, W.
1846. Remarks on the birds observed in Upper California. *Proc. Acad. Nat. Sci.*, 3:110-115.
- Grinnell, J.
1918. Seven new or noteworthy birds from east-central California. *Condor*, 20:88-90.
1926. A new race of the white-breasted nuthatch from Lower California. *Univ. Calif. Publ. Zool.*, 21:405-410.
1928. A distributional summation of the ornithology of Lower California. *Univ. Calif. Publ. Zool.*, 32:1-300.
1932. Type localities of birds described from California. *Univ. Calif. Publ. Zool.*, 38:243-324.
- Grinnell, J., Dixon, J., and Linsdale, J. M.
1930. Vertebrate natural history of a section of northern California through the Lassen Peak region. *Univ. Calif. Publ. Zool.*, 35:vi + 594.
- Grinnell, J., and Miller, A. H.
1944. The distribution of the birds of California. *Pac. Coast Avif. No.* 27:1-608.

Hellmayr, C. E.

1934. Catalogue of birds of the Americas and the adjacent islands. Field Mus. Nat. Hist., Zool. Ser., 13, pt. 8:vi + 541.

Linsdale, J. M.

1936. The birds of Nevada. Pac. Coast Avif. No. 23:1-145.

Mearns, E. A.

1902. Descriptions of three new birds from the southern United States. Proc. U. S. Nat. Mus., 24:915-926.

Ridgway, R.

1904. The birds of North and Middle America. Bull. U. S. Nat. Mus. No. 50, pt. 3:xx + 801.

Simpson, G. G., and Roe, A.

1939. Quantitative zoology (New York and London, McGraw-Hill), xvii + 414.

Van Rossem, A. J.

1936. Birds of the Charleston Mountains, Nevada. Pac. Coast Avif. No. 24:1-65.

Fresno State College, Fresno, California, September 20, 1947.

THE CURVE-BILLED THRASHER IN OKLAHOMA

By GEORGE MIKSCH SUTTON

The Curve-billed Thrasher, *Toxostoma curvirostre*, nests locally, but I believe quite regularly, in the extreme northwestern corner of the Oklahoma Panhandle, at about latitude 37° N., in the semi-arid Black Mesa country of Cimarron County. This habitat, which is at about 4000 feet elevation, hence well below the top of the Black Mesa, and which is close to both the New Mexico and Colorado state-lines, is well over 100 miles east of north from the northeasternmost locality in New Mexico at which *Toxostoma curvirostre* has been known to breed, and fully 250 miles northeast of the northeasternmost tip of the accepted general range of the species in that state (see Florence Merriam Bailey, "Birds of New Mexico," 1928, p. 556). Furthermore, nothing either in the original description of *Toxostoma curvirostre celsum* Moore (Proc. Biol. Soc. Washington, 54, 1941:211-216) or in the A.O.U. Committee's statement of range covering that form (see Twentieth Supplement to the American Ornithologists' Union Check-list of North American Birds, Auk, 62, 1945:446) indicates that any race of *Toxostoma curvirostre* is known to occur in Oklahoma, the Texas Panhandle, or, for that matter, anywhere to the north of those parts of New Mexico indicated in Mrs. Bailey's distribution map. As for the allegedly smaller, lighter-colored race, *Toxostoma curvirostre oberholseri* Law, which is said to inhabit "southeastern Texas and northeastern Mexico (Tamaulipas, Nuevo Leon, and Coahuila)" (see A.O.U. Check-list, 1931, p. 253), the northwesternmost point at which that form was believed by its describer to occur was, apparently, extreme northern Coahuila, a part of Mexico lying approximately 500 miles south of the northwest corner of the Oklahoma Panhandle (see Law, Condor, 30, 1928:151).

Actually, the range of *Toxostoma curvirostre* must be more or less continuous throughout the less mountainous parts of western Texas from northern Coahuila (and Texas directly north of Coahuila) northwestward to the southern boundary of New Mexico and perhaps to the whole of the eastern boundary as well. In Brewster County, Texas, Josselyn Van Tyne and I found it fairly common at least as far north as the Glass Mountains (15 miles northeast of Marathon) and Alpine (see Misc. Publ. Mus. Zool. Univ. of Michigan, No. 37, 1937:71-72). In the Guadalupe Mountain region of Texas, Burleigh and Lowery (Occas. Pap. Mus. Zool. Louisiana State Univ., No. 8, 1940:122-123) found it "common and well distributed in the open desert at the foot of the ridges" in summer.

The race to which these west Texas birds belong is somewhat problematical. Van Tyne and I assigned Brewster County specimens to the nominate race rather than to *oberholseri*, for we felt that the "mass average" differences in wing and tail length between the two races were not great enough to be significant. H. C. Oberholser, on the other hand, believed that at least two of our Brewster County birds—a breeding pair from the vicinity of Glenn Spring, in the southern part of the county—were *oberholseri*. I think he did not publish on this finding, and Van Tyne and I, unaccountably enough, made no comment on the matter in our paper. As for Guadalupe Mountain birds, Burleigh and Lowery called them *T. c. curvirostre*. *Celsum* was not described until 1941, of course. It is regrettable that in the original description of this race there was no discussion of the Texas part of the subspecies' range.

I first encountered the Curve-billed Thrasher in Oklahoma in early June of 1936, not far from the village of Kenton, in the broad, and at that time rather heavily grazed valley of Tesquesquite (locally called "Texakeet") Creek, a tributary of the Cimarron

River. From June 1 to 5 that year I observed a thrasher several times at great distance as it flew from one clump of cholla cactus to another. On June 5, I collected the female (GMS 6884) of one breeding pair, and, a mile or so away, in the same valley, found another pair and its nest, which contained three small young (see Sutton, Auk, 53, 1936:434). The species had not theretofore been recorded anywhere in Oklahoma (see Nicc, "Birds of Oklahoma," 1931).

The following year T. D. Burleigh, G. H. Lowery, Jr., J. B. Semple, K. W. Haller and I saw the Curve-billed Thrasher repeatedly along Tesquesquite Creek, near Kenton, in mid-May, but failed to find the species anywhere else in the Black Mesa country. On May 21, Semple took a singing male (GMS 7457) in which the gonads were greatly enlarged, but we failed to discover the bird's mate or nest. On May 22, I also took a singing male (GMS 7472) whose gonads were greatly enlarged, but whose mate and nest we failed to find. On May 23, Haller and I located a pair of birds, both of which were scolding noisily. Haller found the nest of this pair in the very heart of a dense clump of cholla cactus about four feet from the ground. I collected the female (GMS 6884) and one of the young, all four of which were about ready to leave the nest. The nestling specimen, a female (GMS 7478), had a tail length of 37 mm. Wisps of dark down clung to the tips of the crown, scapular, and lower back feathers (see Sutton, Auk, 55, 1938:505).

Now, whether this Oklahoma breeding population is completely isolated or not—and I refuse to believe that it is—we certainly must include the northwestern corner of the Oklahoma Panhandle in the breeding range of *Toxostoma curvirostre*. But to what subspecies do the birds belong? The four above-mentioned specimens I originally (1936 and 1938) referred to the nominate race, although I was admittedly puzzled by the plainness of the under parts and shortness of the tail in the two males. All three adult birds were, I believed, too long-winged for *oberholseri*, and furthermore I entertained misgivings as to the validity of that race. The spots on the tips of the outer rectrices were clear white, that much was certain: the birds were not *T. c. palmeri* (Coues).

Kenneth C. Parkes has been good enough to send the four moot specimens from Cornell University and I have just re-identified them. The males are certainly far too free of spotting below, especially on the upper belly; too free of buffy tones on the lower belly, flanks, and under tail coverts; and somewhat too pale a gray throughout the upper parts for typical *celsum*. Furthermore, they are too short-tailed for that race, although in each specimen the rectrices are so obviously frayed at the tips as to make the tail-length not wholly satisfactory. As for the female specimen, it is much more readily placeable as *celsum*, not only on the basis of the heavy spotting below and richness of the buffy tone of the lower belly and under tail coverts, but also, surprisingly enough, on the basis of both wing and tail lengths. Measurements of the Oklahoma birds together with the measurements of *celsum* and *oberholseri* as given by Moore and Law (*loc. cit.*), respectively, are given in Table 1.

Study of the above measurements, and direct comparison of the three Oklahoma adults with specimens of *celsum* (from Brewster and Jeff Davis counties, Texas; Fort Bayard, Grant County, New Mexico; Pilaes, Sonora; Chapulco, Puebla; and Jaumave, Tamaulipas) and *oberholseri* (from Cameron, Bexar, and Webb counties, Texas) in the University of Michigan Museum of Zoology collection convinces me that the Oklahoma birds are, on the whole, closer to those of New Mexico than to those of extreme southern Texas. The wing and bill lengths of the Oklahoma males are greater than those of any male of *oberholseri* measured by Law; and the tail length of the Oklahoma males certainly would be somewhat greater were not the feather-tips so badly worn. We cannot be blind to the fact that the Oklahoma males are much more lightly spotted and much

Table 1
Measurements of the Curve-billed Thrasher

	Wing	Tail	Exposed culmen	Tarsus
Adult males				
GMS 7457 (Oklahoma)	111.0	107.0	31.5	34.0
GMS 7472 (Oklahoma)	110.0	109.0	32.0	34.0
18 <i>celsum</i> (Arizona to Durango)	109.7 (103.4-117.0)	112.7 (101.6-121.9)	30.5 (27.1-32.5)	33.3 (31.0-35.0)
10 <i>celsum</i> (Chiri- cahua Mountains)	108.9 (103.8-112.5)	112.4 (107.7-117.3)	31.1 (29.1-32.9)	34.6 (32.6-35.8)
13 <i>celsum</i> (Aguas- calientes to northwestern Guanajuato)	112.0 (107.5-116.6)	112.6 (106.8-124.1)	30.5 (26.9-32.8)	34.5 (33.0-35.8)
10 <i>oberholseri</i> (Lower Rio Grande Valley)	102.9 (98.3-108.4)	105.1 (98.2-110.5)	28.0 (25.8-29.9)	34.4 (32.3-36.2)
Adult females				
GMS 6884 (Oklahoma)	113.0	113.0	29.0	32.0
20 <i>celsum</i> (Arizona to Durango)	107.7 (100.3-115.1)	111.8 (106.0-117.5)	30.0 (27.4-32.0)	32.9 (31.2-34.7)
15 <i>celsum</i> (Aguas- calientes to northwestern Guanajuato)	108.8 (105.1-113.6)	110.6 (105.1-117.0)	28.5 (27.0-31.2)	32.4 (29.3-34.4)

less buffy below than any specimen of *celsum* at hand; but the female Oklahoma bird is very nearly as dark below as the darkest *celsum* in our series, and the fact that this female is actually longer in wing and tail dimensions than either of the Oklahoma males is not to be forgotten. A suspicion lingers that fall males, in fresh, unfaded plumage, would be at least as dark as this female. Possibly the best disposition of the Oklahoma birds at present is to call them intermediate—the males *celsum* in wing length and bill length, the female *celsum* both in size and in color.

How the breeding population of *Toxostoma curvirostre* in northwestern Oklahoma is connected with the range of the species as a whole is, of course, a matter of conjecture at this writing. There certainly is no mountain range, desert or forest of sufficient magnitude to isolate completely the Oklahoma birds from those of southern New Mexico or southwestern Texas. If, as comparison of the maps on page 556 and plate 2 (opposite page 6) in Mrs. Bailey's "Birds of New Mexico" will suggest, the range of the Curve-billed Thrasher coincides with the Lower Sonoran Life-zone in the southwestern quarter of New Mexico, it is natural to believe that the bird may inhabit also the valley of the Pecos River, ranging possibly as far north as Santa Rosa, Guadalupe County. Why it has not been taken along the Pecos I do not know, but I strongly suspect that it occurs there; and, furthermore, I suspect that it ranges northward through the western part of the Panhandle of Texas; thence westward into New Mexico along the Canadian River; and also northwestward (avoiding almost the whole of the Oklahoma Panhandle, which I know from personal observation would not meet the nesting requirements of the species) to the Black Mesa country of extreme northeastern New Mexico, the northwestern corner of the Oklahoma Panhandle, and southeastern Colorado. An important feature of this whole hypothetical Curve-billed Thrasher habitat is the cholla cactus, *Opuntia imbricata* (Haworth) De Candolle, a plant in which the bird indubitably

likes to nest and which is found, according to Britton and Rose ("The Cactaceae," Vol. I, 1919:64) from "Central Colorado to Texas, Oklahoma, New Mexico and Central Mexico." I did not preserve a specimen of the somewhat arborescent cholla in which the Curve-billed Thrashers were nesting near Kenton, Oklahoma, but our expedition's photographs show the plant quite clearly, and Dr. E. U. Clover, of the University of Michigan Department of Botany, who has been good enough to go over this entire matter with me, is convinced that the plant is *Opuntia imbricata*.

The A.O.U. Check-list range of *Toxostoma curvirostre celsum* should, then, include the extreme northwestern corner of the Oklahoma Panhandle. If my belief that the bird breeds wherever *Opuntia imbricata* (or a closely allied cactus) flourishes is at all well founded then it probably will be found also in southeastern Colorado and at various points along the eastern boundary of New Mexico. More field work obviously needs to be done in this promising region.

Museum of Zoology, University of Michigan, Ann Arbor, Michigan, October 29, 1947.

FROM FIELD AND STUDY

A Nesting Record for the Red Crossbill in California.—The following observations were made between August 16 and 19, 1947, at the nesting site of a pair of Red Crossbills (*Loxia curvirostra*) in the Public Camp Ground at Tuolumne Meadows, Yosemite National Park, California. This high mountain meadow is at an elevation of approximately 8600 feet and is bordered by lodgepole pines (*Pinus contorta*) behind which the mountains rise rather abruptly.

The tree in which the nest was discovered was in the open forest along the edge of the meadow within two hundred feet of the main road and within fifty feet of side roads used by campers. One or both of the nesting birds were frequently seen feeding on seeds obtained from the cones of another lodgepole pine that was rather sparsely limbed and about sixty feet from the nest tree. During the three-day period in which observations were made the female was heard at frequent intervals to make a series of soft chirping notes that reminded the writer of the contented sounds produced by week-old chicks that had found warmth after being cold. These notes were uttered also during copulation.

Observations began at 10:00 a.m. on August 16 when a male crossbill was noted feeding in a lodgepole pine. Ten minutes later a female crossbill flew to the same tree and postured in front of the male. The latter then displayed and copulation followed shortly. Both birds then fed in this tree for the next forty minutes. At 10:50 a.m. the female flew to the ground in an unoccupied campsite close by and began to feed on what appeared to be bits of charcoal. In order to pick up the charcoal with her crossed mandibles she was forced to twist her head so that the sides of her bill were horizontal to the ground.

At 11:10 a.m. the female made a short flight, then disappeared in the dense foliage near the top of a nearby sixty-foot lodgepole pine. The observer immediately climbed the tree and discovered her on a nest in a thick cluster of pine needles on the end of a small limb sixteen inches from the trunk and four feet from the top. She appeared to be incubating the one egg which was present and refused to leave the nest until approached within less than fifteen inches. As soon as the observer began to descend the tree she returned. At no time in the course of this procedure did the male come to the nest tree. During most of the afternoon he was seen in the nearby feeding tree. When he occasionally flew by the nest tree calling, the female answered. She was not observed to leave the nest during the remainder of the day.

On August 17 the male was seen opening cones in the feeding tree at 7:30 a.m. The female came to the same tree at 8:10 a.m. and both fed for the following 40 minutes. The female then flew into the thick foliage at the top of the nesting tree and disappeared. No display or posturing was noted this morning. No observations were made between 10:00 a.m. and 4:30 p.m. At 4:45 p.m. a male, presumably one of the nesting pair, was heard singing from the top of a nearby tall pine. The soft, twittering notes of the female were heard to come from the top of the nest tree until darkness settled over the meadow.

On August 18 the male was seen opening cones in the feeding tree at 8:00 a.m. At 8:40 a.m. he uttered several call notes and was immediately answered by the twittering notes of the female in the nest tree. The male then flew to the top of the nest tree and disappeared in the dense foliage. Shortly after this notes indicating copulation issued from the top of the tree and were heard for about five minutes. The male then returned to the feeding tree where he was observed several times later in the day. An electrical storm settled over the area at about 2:00 p.m. and lasted until dark. At 6:15 p.m. the male was seen on the top of a tall pine near the nest. Call notes were heard coming from the nest at 6:45 p.m. and 25 minutes later the female was seen to leave. Approaching darkness prevented further observation.

At 7:30 a.m. on August 19 the male was observed opening cones. At 7:55 a.m. the female was heard calling from the nest site. The male answered but did not go to her. When the observer climbed to the nest at 9:50 a.m. the female refused to leave until a hand was placed on the edge of the nest. She then gave a series of alarm notes and took up a position about three feet away. This attracted the male who also came to the top of the nest tree. Both birds were photographed several times.

Three eggs were in the nest at this time. They were a light grayish blue spotted with both faded and sharp brown spots on the larger end. One of the eggs had a dark brown line among the spots similar to the markings of a Lark Sparrow (*Chondestes grammacus*) egg.

The nest frame itself was composed of loosely woven twigs and long grass stems very poorly fastened among the pine needles. The cup was compact and well constructed, being lined with grass, feathers, hair, and several pieces of yellow string. The outside measurements were $3\frac{1}{2}$ inches in diameter and 3 inches in depth. The inside measurements of the cup were $2\frac{1}{2}$ inches in diameter and $1\frac{3}{4}$ inches in depth.

The observer left Tuolumne Meadows this same morning, preventing further observations on the nesting activities of this pair.—EBEN MCMILLAN, Cholame, California, October 22, 1947.

The Starling in Arizona.—The first authenticated record of the Starling (*Sturnus vulgaris*) for Arizona was obtained on November 16, 1946, when I collected an adult at Parker, Yuma County. Subsequently, another was collected, and as many as 34 were seen at Parker and on the Colorado River Indian Reservation on January 1, 1947. I also saw them on the California side of the Colorado River, about five miles southeast of Needles, San Bernardino County, on December 18, 1946, and on February 23, 1947, when 45 were counted. None was seen after March 1.

I saw a flock of about forty Starlings on February 9, 1947, not far east of Joseph City, Navajo County, Arizona, from a passenger train on the Santa Fe Railway.—GALE MONSON, *Fish and Wildlife Service, Parker, Arizona, July 18, 1947.*

Does the Poor-will "Hibernate"?—While going up through a very narrow, high-walled, almost slot-like cañon in the Chuckawalla Mountains of the Colorado Desert two of my students and I saw on December 29, 1946, a most unusual sight. On the side-wall about two and a half feet above the sand of the cañon bottom was a Poor-will (*Phalaenoptilus nuttallii*) resting head-upward in a vertical rock-hollow, its gray and black, mottled plumage blending so perfectly with the coarse gray granite that we had to look twice to convince ourselves it was really a Poor-will. The shallow crypt, with deepest part above, was just a little more than large enough to hold the bird, hence its back was almost flush with the rock surface. When we had observed the bird quietly for more than ten minutes without noticing any motion, I reached forward and touched the bird without evoking any response. I even stroked the back feathers without noticing the slightest movement. Was our bird dead, sick or just deep in winter sleep? We left the place for awhile, then about two hours later returned. The Poor-will was still in the same position. I now reached forward and picked it up, freely turning it about in my hands. It seemed to be of unusually light weight and the feet and eye-lids when touched felt cold. We made no further attempt to be quiet; we even shouted to see if we could arouse our avian "sleeper." I finally returned it to its place in the crypt; but while I was doing this I noticed that it lazily opened and shut an eye, the only sign I had that it was a living bird. Unfortunately we soon afterward had to leave the place and return home without making further observations.

Ten days later at about ten o'clock in the morning I returned with Mr. Lloyd Mason Smith. To our great surprise and satisfaction the Poor-will was still there in its rock niche, with every indication that it had not moved "even so much as a feather" in the intervening time. I reached forward and as before carefully picked it up. But this time instead of remaining perfectly quiet, it gave several "puffy" sounds as if expelling air from the lungs, opened an eye, and began to make a variety of queer high-pitched whining or squeaky mouse-like sounds. After some moments it opened its mouth widely as if yawning and then resumed its quiet. As Mr. Smith further handled it, it again made the whining notes; then suddenly it raised both wings and held them in rigid, fully outstretched upright position. The eyes remained closed. After the bird had held the wings stiffly upward for several minutes we worked together to put them back in normal position; several times we attempted this but always the wings came quickly back high above the head until the tips almost touched. Some five minutes later while one of us still held the bird, we tried again, this time more successfully, for we got the wings at least partially in position. We now put the Poor-will back in its crypt as best we could and left. The morning was cool (42° F.), the sky overcast.

That afternoon while the sky was still gray with clouds we returned for further observations. We had put the bird into its crypt not quite in normal position and with feathers somewhat ruffled and wings askew, and so it was now when we found it after an absence of three hours. Mr. Smith picked up the Poor-will hoping to photograph it while I held it in my hand. But to our great surprise it whipped open its wings and flew out of hand in perfectly normal flight as if it had only been playing 'possum all the time but now had suddenly become alert to danger. It flew about forty feet up-cañon into an iron wood tree (*Olneya tesota*). We walked toward it and again it flew, alighting this time among some rocks high above us and where we were unable to reach it.

On this day there were fresh coyote tracks directly below the Poor-will's roosting site. The position of the foot prints indicated that the coyote had stopped and turned toward the bird. There were fresh feces and claw marks in the sand, all indications that he had remained there a number of minutes. Perhaps he even saw or smelled the bird, for it probably was perching there on the side of the rock at about the level of his eye.

On November 26, 1947, a Poor-will, probably the same bird, was in the same crypt, and again it was lethargic. On December 6 it was banded.

I am not venturing here to state any conclusions, but this experience leads me strongly to suspect that one reason that so little is known and written about the winter habits of Poor-wills is because the birds then for the most part hide away and perhaps spend a short period in a kind of somnolence at least somewhat akin to true hibernation. Culbertson (Condor, 48, 1946:158-159) found a Poor-will hidden in a rotten log and in sort of a torpid state of low metabolism. I take this as a partial corro-

boration of my belief that a period of winter inactivity among Poor-wills may be more common than we have supposed.—EDMUND C. JAEGER, *Riverside College, Riverside, California, December 15, 1947.*

Eastern Kingbird in San Bernardino Valley, California.—Bruce E. Cardiff and the junior author of this note observed a kingbird in their berry field in Bloomington, San Bernardino County, California, on August 25, 1947. The bird was collected and proved to be an immature female Eastern Kingbird (*Tyrannus tyrannus*) and a new record for the San Bernardino Valley, California. The specimen is no. 312 in the Cardiff collection of mounted birds.—WILSON C. HANNA, *Colton, California*, and EUGENE E. CARDIFF, *Bloomington, California, October 5, 1947.*

Second Record of the Golden-crowned Sparrow in Utah.—On the evening of October 4, 1947, while collecting at Standrod, 5500 feet, Boxelder County, Utah, on the north side of the Raft River Mountains in the northwestern part of the state, I noticed two large sparrows frequenting tall grass and willows bordering a small stream. It was difficult to observe them because of their quick flights in and out of the willows, but they were recognized as being zonotrichias. One was finally taken and proved to be a Golden-crowned Sparrow (*Zonotrichia coronata*). This is the second record of the species for Utah, and the first from the northern part of the state. The previous record was reported from Zion National Park by Long (Condor, 38, 1936:89).

The bird from the Raft River Mountains was associated with Song Sparrows when seen. The next day an attempt was made to take additional specimens, but all the sparrows of both species seemed to have continued on their southward migration.—CLIFTON M. GREENHALGH, *Department of Biology, University of Utah, October 27, 1947.*

An Early Record of the Western Kingbird in Lane County, Oregon.—The Western Kingbird (*Tyrannus verticalis*) is an uncommon summer resident in the southern Willamette Valley of western Oregon. As a common bird east of the Cascade Mountains, its season runs from early April to late August, according to Gabrielson and Jewett (Birds of Oregon, 1940). It was thus with considerable surprise that I found one feeding along the edge of a walnut orchard on the north bank of the Willamette River at Eugene on February 28, 1947. This bird was very active and food seemed to be abundant. It was doing all its catching within four feet of the ground. Although it frequently dropped to the ground to pick up an insect, it remained only a few moments, returning quickly to perch on a low walnut branch or stalk of the woolly mullein.

This record is the earliest spring date for Oregon for this species by more than a month. Though the preceding winter was not unusually mild, numerous summer visitors returned early or remained through the cold season.—GORDON W. GULLION, *Eugene, Oregon, October 4, 1947.*

Horned Owl Feeding on Garter Snake.—Late in the morning of September 9, 1947, just as the coastal fog was breaking up and permitting the sun to shine through, I witnessed an immature Horned Owl (*Bubo virginianus*) feeding on a freshly killed garter snake (*Thamnophis sirtalis infernalis*). The event took place near the Skyline Boulevard, about 4½ miles south of the San Francisco County line in San Mateo County, California. I obtained the remains of the snake for verification by scaring the bird into flight at a moment when it had laid the snake on the ground. The size of the remains indicated that the snake had been about 2½ feet long. About half of it was missing and presumably had been eaten. The young owl flew very poorly about 50 yards across a pond beside which it had been feeding and landed on the ground on the other side. There were no trees in the vicinity.—WADE FOX, *Museum of Vertebrate Zoology, Berkeley, California, October 4, 1947.*

An Albino Eared Grebe at Mono Lake.—On August 24, 1947, my wife and I observed an albino Eared Grebe (*Colymbus nigricollis*) on Mono Lake, Mono County, California. It was swimming near the western shore in the company of a group of normally colored examples. Since the shoreline at this point borders the highway, we were able to view the grebes at close range.—KEN STOTT, JR., *Zoological Society of San Diego, San Diego, California, September 4, 1947.*

NOTES AND NEWS

The colored life-size portrait of the Zone-tailed Hawk (*Buteo albonotatus*) by the late Allan Brooks, reproduced as the frontispiece of this issue, is based on a specimen in his collection. Its label is typical among Brooks' own specimens and provides the following information: The hawk, an adult male, was shot at its nest on April 4, 1939, in Madera Cañon, at 7500 feet, Santa Rita Mountains, Arizona. Nest-building was underway on that date. The hawk weighed 1 pound, 7½ ounces. Its stomach contained scales of a lizard (*Sceloporus*). Colors of soft parts were: eye, dark warm sepia; eyelid, pale yellowish on edge; orbital ridge, cere, gape, and feet, cadmium yellow (medium); bill, black, paler at base of both mandibles.

The original of the frontispiece is one of a small series of color portraits, black-and-white sketches, and pencil drawings donated generously by Mrs. Marjorie Brooks and Allan Cecil Brooks to the Cooper Ornithological Club and exhibited at its annual meetings in Los Angeles, in May, 1947. The collection consists entirely of previously unpublished work contained in Brooks' sketch-books. Even though he probably thought of these sketches and paintings as only preliminary ones, they impress us as real additions to the record of his work. Two items from this collection were published last year: a black-and-white drawing of the head of a Horned Owl (Condor, 49, 1946: opposite page 137), and a pencil sketch of a group of Canada Geese (same volume, opposite page 217). Reproduction in *The Condor* of several colored paintings by Brooks is made possible through donations by members of the Cooper Ornithological Club toward a special fund set up for this purpose.

At a recent meeting of the Club's Board of Directors, authorization was given for appointment of Robert W. Storer as Assistant Editor on the staff of *The Condor*.

Numerous requests for ornithological reprints and bird books have recently come to this country from European ornithologists who have lost their entire libraries in consequence of the war. The desire for ornithological literature among these colleagues (bird lovers as well as professional ornithologists) seems to be as great as that for food and clothing. Perhaps you have a dozen or two extra reprints of some of your papers which you could spare. Papers dealing with any aspect of the general biology of birds, particularly life-history studies, are especially welcome. It would be much appreciated if you would mail such reprints to Ernst Mayr, American Museum of Natural History, Central Park West at 79th Street, New York 24, New York, or to Frank A. Pitelka, Museum of Vertebrate Zoology, Berkeley 4, Cali-

fornia. Please mark packages "A.O.U. Relief Committee." All reprints so received will be distributed at once among active European bird students.—AMERICAN ORNITHOLOGISTS' UNION RELIEF COMMITTEE.

The November issue of *British Birds* (vol. 40: 322-325) carries an article entitled "Cabinet Colour-changes in Bird-skins and Their Bearing on Racial Segregation," by Reginald Wagstaffe and Kenneth Williamson of the Yorkshire Museum. We quote from their article: "Although the occurrence of post-mortem changes in the colours of bird and mammal specimens has been noted by other workers . . . , it is evident to us that the grave seriousness of its implications in systematic work has not been fully appreciated In a good many instances the significance not only of the time-hallowed holotype, but of all primary types, is greatly diminished. The claim that this, or that or the other, 'has been compared with the type,' can no longer be accepted as irrefutable evidence of the validity of any colour-differences observed. [Italics ours.] The types of some races, in which structural differences are not involved, may prove to have no longer any but historical importance For all practical purposes, however, it seems that a greater significance must be attached to the type-locality than has been the case hitherto, for until these changes can be averted, the substitution of holotypes and paratypes in affected cases by fresh topotypical material at intervals of a few years, will become essential if reliable comparative work is to continue, and the fundamental tenets of taxonomic procedure upheld."

It is appropriate to this, the Fiftieth Anniversary Volume of *The Condor*, that we look back over records of past decades to recall some events in the history of the Club and its members, as revealed by news items from editorial pages.

1900—"As an illustration of the knowledge accruing from proper collecting in the field, we might call attention to the communication of Mr. Jos. Mailliard in this issue on color changes in the crown of certain of the *Picidae* This demonstrates the necessity of collecting in series at proper seasons, and it would seem that all unbiased ornithologists must concede that the results amply justify such collecting" (p. 22). [C. Barlow.]

"Wilfred H. Osgood of the Biological Survey . . . with Edmund Heller . . . has returned from a successful expedition into British Columbia where large collections of zoological and botanical specimens were made. The expedition worked from Vancouver Island north to Unalaska" (p. 145).

"The [R. H.] Beck Expedition to the Galapagos Islands . . . will sail from San Francisco about Nov. 15" (p. 145).

1910—"We take this opportunity of calling attention to the very great value to American ornithology of the review department of *The Auk* . . . We have come to feel assured that practically nothing has escaped notice in its review columns; and if the review notice that we are after and do find, is critical and above the initials 'J. A. Allen,' with what close attention is it read" (p. 47). [J. Grinnell.]

"We are in receipt of an announcement of the organization in New York City, on December 8, 1909, of the American Bird Banding Association, the object of which is 'the banding of wild birds and the recording of accurate data on their movements.' . . . This method of study, tho new in this country . . . promises interesting results . . ." (p. 81). [H. S. Swarth.]

"The first expedition of 1910 to take the field in the interest of the . . . Museum of Vertebrate Zoology, left on February 13. The party is headed by Mr. J. Grinnell, who is assisted by Messrs. F. Stephens, J. Dixon and H. Jones; the field of their endeavors is the valley of the Colorado River . . . The same trip was made by Dr. Elliot Coues, years ago, when the country was new and unknown . . ." (p. 81).

1920—"It is a source of gratification to those who have given time and energy in promoting the welfare of the Cooper Club to learn that several of the members . . . some time ago started an endowment fund for the Club. A committee, consisting of J. E. Law, W. L. Chambers and A. B. Howell, has now been elected to take charge of the soliciting of contributions to this fund . . . the interest on which is to be used for the purposes of enlarging *THE CONDOR* and publishing *Avifaunas*" (p. 44). [J. Grinnell.]

"Doubtless many bird students join us in our feeling of dismay regarding the very great number of new names and combinations of names being proposed in current literature . . . Very many of these changes are due to splitting of genera or else to the introduction of trinomials on the ground of supposed intergradation through individual variation. Both of these practices are of a sort to be closely dependent upon personal opinion and not upon well definable conditions in nature" (p. 44).

"The National Parks Service is this year inaugurating a system of instruction in natural history for visitors to Yosemite National Park. Two members of the Cooper Club [Dr. H. C. Bryant and Dr. L. H. Miller] will conduct this work during the season of 1920" (p. 112).

"The W. Otto Emerson collection of bird skins, numbering about 5500, has been purchased for the California Academy of Sciences by two public-spirited members of that body, Messrs. John W. Mailliard and W. H. Crocker" (p. 207).

"Collectors should bear in mind that for many reasons the autumn season is the most favorable time of the year for securing specimens. Plumages are then complete and unworn . . . Adequate value, scientifically, is to be secured from a dead bird, only by recording, in addition to the usual data, its weight, its age (as determined from the condition of the skull), and the colors of the soft parts . . ." (p. 192).

1930—"The Cooper Ornithological Club was represented formally at the Seventh International Ornithological Congress . . . in Amsterdam. The Club's delegates were: Mr. Harry S. Swarth, who also spent part of the summer working in the museums in London and Tring; . . . Dr. Casey A. Wood . . . and Dr. Alexander Wetmore . . ." (p. 266).

"We know, not one, but at least three individuals, who dislike the Mockingbird. By such persons, the Mockingbird, blatant, loud of voice, not content to announce itself only by day, is an irritation, to be gotten rid of in any neighborhood. Some other people hate Blue Jays; others are offended by the aggressive attitude of Brewer Blackbirds in the nesting season and demand to be rid of them; . . . and so it goes . . . Logically, if all such complaints are to be heeded, then the only thing to do is at once to undertake wholesale extermination of every living wild bird and mammal! . . . The tendency manifest in various directions promptly to yield to pressure from minority interest to eradicate 'pests' can, we think, lead directly or indirectly only to the complete wiping out of a large part of our native fauna.—J. G[rinnell]." (p. 266).

"The Cooper Club's business staff has been augmented by the addition to it of Mr. John McB. Robertson . . . [He] will take over from Mr. W. Lee Chambers certain of the routine that has fallen to the latter's lot in increasing measure. . . . It should be fully realized by our membership that every hour of service rendered by each of our business managers is an outright gift to the Club . . ." (p. 74).

1940—"Realizing that ignorant or wanton shooting of this beneficial bird [the White-tailed Kite] is a considerable factor in its depletion, Mr. Laidlaw Williams and I have for several years advocated an attractive poster which would . . . make a plea for its preservation . . . It is thought that broader education, along these lines, of individuals likely to see kites will work for the birds' protection . . . —James Moffitt" (p. 310).

For Sale, Exchange and Want Column.—Each Cooper Club member is entitled to one advertising notice in any issue of *The Condor* free. Notices of over ten lines will be charged for at the rate of 15 cents per line. For this department, address JOHN MCB. ROBERTSON, Buena Park, California.

FOR SALE—Information about the last-remaining two sets of the Author's Edition, de luxe, of *The Birds of Washington*, by Dawson and Bowles, may be had upon inquiry; these sets have uncut pages, and they are the last available. Also a few paintings by Brooks and some colored reproductions.—MRS. WILLIAM LEON DAWSON, 1514 Garden St., Santa Barbara, Calif.

FOR SALE—Rope ladders especially made from high quality nylon and aluminum to meet the needs of the practical ornithologist. Exceedingly light, strong and compact; they insure complete safety in reaching difficult locations. For specifications and prices write.—S. KENT CARNIE, 1249 Latham St., Mountain View, Calif.

FOR SALE—Large oological collection consisting principally of sets of North American bird eggs, but some choice foreign ones; also large number of bird skins for study or mounting. Collected for scientific purposes by late Franklin J. Smith of Eureka, Calif. All in cases and may be inspected any time.—JANE SMITH CHAMPLIN, 1019 Channing Way, Berkeley 2, Calif.

WANTED—Birds of the Hawaiian Islands by H. W. Henshaw, 1902 (T. G. Thrum Co., Honolulu). —D. AMADON, *American Museum of Natural History, Central Park West, New York 24, N. Y.*

WANTED—Roosevelt Wild Life Bulletin, vol. 1, no. 1 (Dec. 1921); Annual Report, Superintendent Yellowstone National Park for 1907, by T. S. Palmer; Natural History, Jan. 1919 (vol. 19, no. 1); *The Practical Value of Birds*, by Henderson.—HENRY BIRKELAND, Roland, Iowa.

WANTED—Transactions 7th and 8th North American Wildlife Conferences and Pittman-Robertson Quarterly, vol. 1, no. 2. Have Transactions 2nd North American Wildlife Conference and Leopold "Game Management" for trade.—A. STARKER LEOPOLD, *Museum of Vertebrate Zoology, Berkeley 4, California.*

WANTED—Information on "The Birds of Washington." I am trying to locate a copy of Dawson and Bowles' "The Birds of Washington," Spokane edition de luxe. This was supposed to have been issued in an edition of 35 copies and up to this time I have not been able to locate a single set. Please send me any information you may have.—W. LEE CHAMBERS, Topanga, California.

